Accomplishments in Tobacco Research in North Carolina

March 1, 1985 - February 28, 1986

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This information presented in the annual report is NOT FOR PUBLICATION but represents preliminary findings which may later appear in published form. We trust you will find this information of interest and value.

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PREFACE

The North Carolina Agricultural Research Service supported 66 projects on various aspects of tobacco research in 1985. Fifty-two faculty members from 10 of the 20 departments in the School of Agriculture and Life Sciences devoted 21.9 scientist years (full-time equivalence) to tobacco research. Total expenditures during 1985 were approximately $4.93 million, an increase of about $0.44 million over 1984. It is of interest to note that 17 years ago (1968), 34 faculty from nine departments devoted 24.6 scientist years to tobacco research with expenditures of approximately $1.4 million. Total support years (SY) for tobacco research in 1985 (includes scientists, technicians, post-doctorals, and clerical) were 102.0 SY, down from 106.2 in 1984.

The USDA-ARS Oxford Tobacco Research Laboratory at Oxford, N. C. is an essential component of our total tobacco research program. The above data do not include federal dollars expended in support of this laboratory.

Supplemental support provided by growers, warehousemen, leaf exporters and manufacturers of tobacco products through the North Carolina Tobacco Foundation continues to stimulate project leaders to strive for a "margin of excellence' that might not be attainable with support only from appropriated funds. Mrs. Isabelle Fletcher of Lenoir County provided outstanding leadership as President during her second term during 1984-85. Dr. Larry M. Sykes of Philip Morris, Richmond, Virginia was elected in October to serve as President for the 1985-86 term.

Since our last report three additional faculty have been added to our tobacco staff. Dr. Mark A. Conkling, Assistant Professor of Genetics; Dr. Dennis W. Keever, Entomologist (USDA), located at the Oxford Tobacco Research Laboratory; and Dr. Sally M. Schneider, Assistant Professor of Plant Pathology (USDA), also located at the Oxford Tobacco Research Laboratory. We welcome these faculty as a part of our "tobacco family", and feel confident that their expertise will contribute significantly to our overall tobacco research program in North Carolina.

During 1985, Dr. Kenneth R. Keller, former Assistant Director in Charge of Tobacco Research and Director of the the North Carolina Agricultural Research Service, died. While we are deeply saddened by this loss of a great associate and leader in the tobacco industry, we shall always remember him for his dedication to tobacco, his many accomplishments in furthering the overall unity at the various segments of the industry, and his care and concern for all aspects of our tobacco research and extension programs at North Carolina State University.

This report on "Accomplishments in Tobacco Research in North Carolina" (March 1, 1985 - February 28, 1986), provides essentially a summary of the various activities by both NCARS and USDA personnel working collectively on various tobacco projects. The broad scope of activities underway is evidence of a continued concern by our faculty to maintain and strengthen our overall effort, which will benefit our farmers by helping them achieve improved quality and a profitable production system through new technologies. We are

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pleased that we have been able to strengthen various aspects of our tobacco research program during 1985, particularly in the areas of genetics, breeding, and objective measures of quality. We are pleased with the overall accomplishments in tobacco research during 1985 and look forward to new and exciting challenges of the 1986 year.

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Title: NC

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I. Summary

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Table 1. E
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Compound
None
Ethylene
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2,5-NBD
2,5-NBD +
2,4-D + 2

2,4-D

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Title: NC 03551 Action of Ethylene on Tobacco Plants and Tissues

Project Leader: Edward C. Sisler

I. Summary of Research:

This project has the following objectives:

A. To study the chemical parameters of ethylene activity.

B. To purify the ethylene-binding site to homogeneity.

Studies have been conducted on the effect of ethylene and 2,4-D on chlorophyllase, an enzyme involved in the yellowing process in tobacco. Ethylene induces this enzyme, and the effect of ethylene is readily reversed by the ethylene blocking agent 2,5-norbornadiene. 2,4-D also causes an induction of this enzyme at a concentration of 2×10^{-5} M. The inductive effect of 2,4-D can be reversed by 2,5-norbornadiene. This strongly suggests that the inductive effect of 2,4-D is via ethylene, whose production is induced by 2,4-D (Table 1).

Tobacco seeds do not respond to ethylene treatment; however, if the ethylene blocking agents 2,5-norbornadiene or silver ion are applied, then ethylene stimulates the germination of tobacco seeds (Table 2). The use of aminooxyacetic acid, a compound which blocks ethylene production, also makes the seeds responsive to ethylene. Another blocking agent, Co^{++} ion, does not prevent germination, suggesting the requirement is very low (Table 3).

Efforts to purify the ethylene-binding component have continued. Extraction of the component with a neutral or anionic detergent gives good results. The use of the cationic detergent laurel amine causes a loss of binding which appears to be restored upon its removal. This raises the possibility that certain amine compounds may be involved in the regulation of this hormone in vivo. This possibility is being investigated.

Table 1. Effect of Various Compounds on the Level of Chlorophyllase in Tobacco Leaves

Compound	Chlorophyllase Activity µg/g fresh wt/hr
None	3.5
Ethylene	9.8
2,4-D	6.1
2,5-NBD	3.2
2,5-NBD + Ethylene	10.8
2,4-D + 2,5-NBD	2.0

2,4-D was 2×10^{5} M, 2,5-NBD was 2000 µl/l, and ethylene was 1000 µl/l.

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Table 2. Effect of Compounds Which Block Ethylene Action on Tobacco Seed Germination

Treatment	Concentration	Days to Germination	
		- Ethylene	+ Ethylene
None	-	7	7
2,5-Norbornadiene	4000 µl/l	16	11
	8000 µl/l	26	14
$AgNO_3$	1×10^{-3} M	6	6
	5×10^{-3} M	-	27

$AgNO_3$ treatment was in the dark. Ethylene concentration was 2000 µl/l.

Table 3. Effect of Various Chemicals Inhibiting Ethylene Production on Tobacco Seed Germination

Chemical	Concentration (M)	Days to Germination	
		- Ethylene	+ Ethylene
None	-	7	7
$CoCl_2$	1×10^{-3}	6	7
	5×10^{-3}	6	7
Aminooxyacetic acid	1×10^{-3}	7	7
	2×10^{-3}	10	10
	3×10^{-3}	20	13

Ethylene concentration was 2000 µl/l.

IV. Publications:

Sisler, E. C., Reid, M. S., and Yang, S. F. 1985. Effect of silver ion and 2,5-norbornadiene on ethylene binding in carnation. Plant Physiol. 77:S128. (Abstract)

V. Manuscripts Accepted for Publication:

Goren, R., and E. C. Sisler. 1986. Ethylene-binding characteristics in Phaseolus, Citrus, and Ligustrum plants. Plant Growth Regul.

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Beggs, M. J., and E. C. Sisler. 1986. Binding of ethylene analogs and cyclic olefins to a Triton X-100 extract from plants: comparison with in vivo activities. Plant Growth Regul.

Sisler, E. C., and Yang, S. F. 1986. Ethylene. In "Model Building in Plant Physiology/Biochemistry," (Newman, D., and Wilson, K., eds) CRC Press, Inc.

Sisler, E. C., Reid, M. S., and Yang, S. F. 1986. Effect of antagonists of ethylene action on binding of ethylene in cut carnations. Plant Growth Regul.

Brown, J. H., Legge, R. L., Sisler, E. C., Baker, J. E., and Thompson, J. E. 1986. Ethylene binding to senescing carnation petals. J. Exp. Bot.

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TITLE: NC 05540 Automated Transplant Culturing and Transplanting in Tobacco Production

PROJECT LEADER: B.K. Huang

I. Summary of Research:

Tobacco plantbed and field transplanting operations remain in a major bottleneck in the complete mechanization of the tobacco production system. The two most significant difficulties associated with the mechanization are the production of uniform transplants and the actual field transplanting. Both of these operations are labor intensive and require high labor for short time periods. Labor cost and availability, as well as the inherent difficulties of seedling handling and inaccuracy of hand feeding are the key problems to be resolved. Many attempts have been made worldwide to develop automated field transplanters and seedling production systems, but without wide acceptance by the industry.

Transplanting containerized seedlings can provide several advantages over bareroot seedlings; easier mechanization, better control of transplant timing, increased survival rate, uniform plant population, uniform maturity, higher yield, and reduced water requirements to improve overall plant quality and economics. Increasing numbers of tobacco growers in the Southeast have started to practice the production of tobacco transplants under a greenhouse environment to improve transplant quality, uniformity, and growth as well as to increase greenhouse space utilization. An arrangement was made to work with tobacco farmers who had been producing containerized transplants in Louisburg, N.C. to observe their automated greenhouse containerized transplant production. They were advised on proper cell sizes, root formation, and greenhouse environmental control. Two University patents on "Automatic Transplanter" and "Seedling Growing and Handling Device" were licensed in 1985 for commercialization to accelerate commercial development and manufacturing of fully automatic transplanter and University tray.

As the increasing numbers of tobacco growers are using a greenhouse for containerized transplant production, the environment control of a greenhouse becomes increasingly important. Environment conditions of a greenhouse system was studied by developing the electronic circuit analysis program considering radiation, convection, conduction and reflection factors. The results showed that the simulated dynamic environmental behavior conform well with the measured results.

Materials and Methods

The greenhouse solar system setup for greenhouse mode for automated transplant production is shown in Fig. 1. The portable frames serve as a multiple layer seedling production system (left) and the rotary drums are converted to a ferris wheel to serve as a rotary layer seedling production system (right). The basic structure consists of a quonset shaped greenhouse structure with corrugated fiberglass cover (12.2 m long by 7.6 m wide by 3.7 m high, oriented north and south longitudinally) acting as the solar collector

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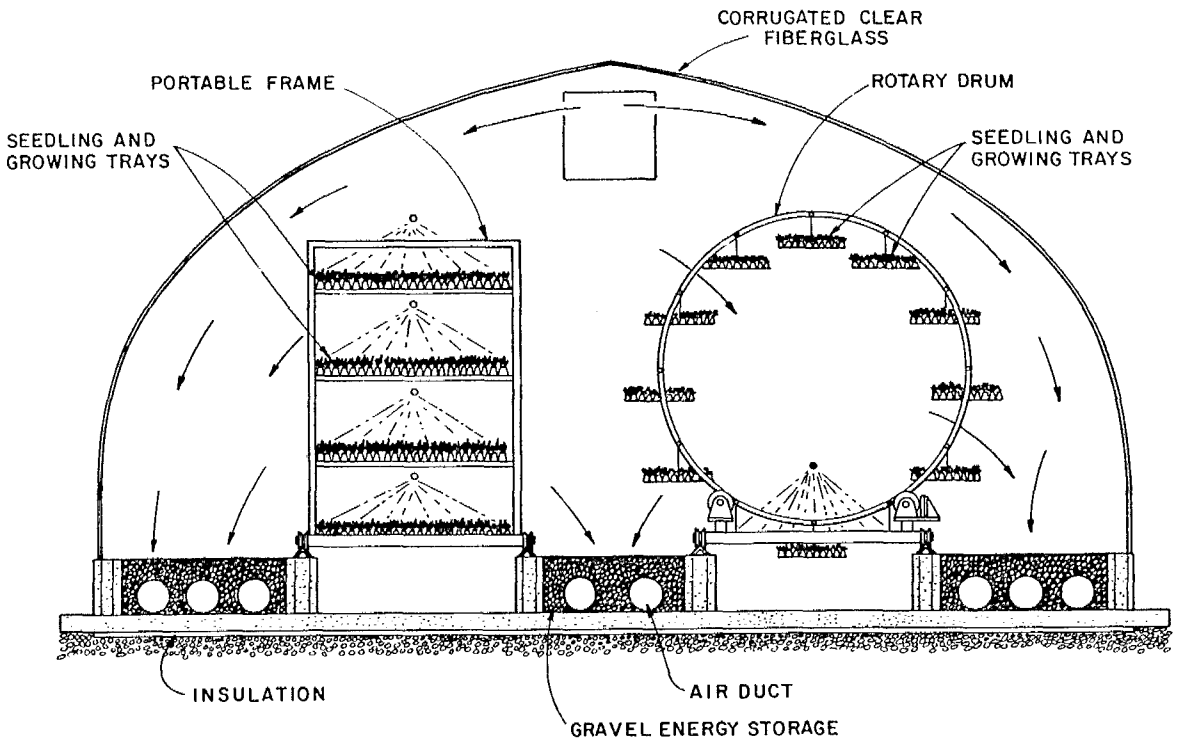

Fig. 1. Greenhouse solar system setup for greenhouse mode operation with stationary and rotary layer automated seedling production systems.

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glazing, and an enclosed and insulated furnace room, top air duct and a gravel energy storage system acting as the collector heat absorbers to form a large multi-directional solar collector. The system is equipped with an oil furnace with temperature, humidity, and airflow controls.

The total greenhouse solar system is divided into five parts in developing the thermal circuit for the system. The five parts consist of the main part of the greenhouse section up to the south wall of furnace room; two upper parts enclosed by the north wall, the east and west roofs of the furnace room, and the fiberglass; two lower parts enclosed by the north wall, the east and west walls of the furnace room, the surfaces of the east and west gravel storage, and the fiberglass. The thermal energy exchange between the four small enclosed parts (upper east and west, lower east and west) and the main part was considered to be negligibly small.

The air temperatures were measured and recorded using thermocouples (Co-Cu) and a multipoint recorder. The main part was divided into four sections with three thermocouples distributed vertically at the center of each section to obtain a representative average inside air temperature. North wall and furnace room wall temperatures were also recorded by attaching thermocouples on the walls.

The solar heat input at various surfaces in the greenhouse, gravel storage, concrete foundation, and furnace room, and outside total and diffused solar radiation were measured by a radiometer (Model DSP, Eppley Laboratory, Inc., Newport, Rhode Island) and a DC millivolt meter (Model 268, Digitec United System, Co.) every hour.

Analytical Procedure

Electrical systems are analogous to many other systems such as mechanical systems, hydraulic systems, thermal systems, etc. Any system which has electrical analogies may be simulated with circuit network without formulating the mathematical model. In the thermal systems the method rests on the fundamental similarity between the flow of heat within a rigid body and that of charge in a noninductive electric circuit. The analysis is based directly on the identity of equations governing transient heat flow and the flow of electricity in resistance-capacitance circuit. In a thermal network, thermal potentials are temperatures (°C), thermal currents are heat flow rates (J/s), thermal resistances are heat flow resistances (°C/(J/s)), thermal capacitances are heat storage elements (J/°C), and thermal sources or sinks respectively produce heat or receive heat (J/s).

In general, analyzing a system by the thermal circuit method requires: (i) describing the system completely with a sketch including dimensions, thermal properties, system input in temperature and/or heat flow rate, and independent variables in the surroundings; (ii) drawing the thermal circuit; (iii) calculating resistances and capacitances; (iv) writing the circuit equations; (v) solving the circuit equations; and (vi) interpretating the results. Utilization of an electronic circuit analysis program with digital computer would reduce steps (iv) and (v) into simple programming and computer

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TABLE 1. NC

Symbols

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R_{ri} = inside

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C = capacit

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run including computer plotting. Princeton Circuit Analysis Program (PCAP) which is a modified and improved version of Electronic Circuit Analysis Program (ECAP) was applied to steps (iv) and (v) in this study.

In analyzing the basic components of the greenhouse system consider that a solid mass is changing temperature as a result of heat exchange between the mass and the surroundings. There are variable temperature gradients in the mass which are a series of isothermal surfaces related to the time rate of heat gained or lost.

In drawing the thermal circuit for the greenhouse solar system, the system components are idealized and represented by circuit elements. The symbols for the circuit elements are described in Table 1.

TABLE 1. NOMENCLATURE AND SYMBOLS.

Symbols	Subscripts
R = conduction resistance	d = top air duct
R_{co} = outside convection resistance	f_1 = tilted fiberglass wall
R_{ci} = inside convection resistance	f_2 = vertical fiberglass wall
R_{ri} = inside 'surface' radiation resistance	g = gravel energy storage
R_{sn} = inside 'space' radiation resistance	h = heat absorber (furnace room)
C = capacitor	w = heat absorber (wall)
T_i = inside temperature	a = air space
T_o = outside air temperature	e = electrical circuit element
I = solar radiation input	t = thermal circuit element
R_e = equivalent resistance ($\approx 5000 \times 10^3$ ohms)	
θ = time	

In working out a proper thermal circuit for the greenhouse solar system, it is assumed that the net long-wave radiation exchange between the outer surface of the fiberglass wall and the surroundings is small and can be included in its convection heat transfer. Thermal-energy transfer through all structural elements is considered to be unidirectional and perpendicular to the long dimension. Each of the distributed property section is replaced by lumped property section and all lumped thermal properties are considered to be

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constant over the temperature range encountered. The air mass in the enclosed space is considered to be at a uniform temperature at any instant. The system thermal networks are respectively shown in Figs. 2, 3 and 4 for the main part, upper east and lower east parts. Networks for the upper west and lower west parts are basically the same as those for the east parts. The thermal properties of materials used in this experiment are shown in Table 2.

TABLE 2. THERMAL PROPERTIES OF MATERIALS.

Material	Thermal Conductivity (J/(s·m·°C))	Heat Capacity (kJ/kg·°C))	Mass Density (kg/m³)
Fiberglass (t = 1.016 x 10^{-3} m)	0.0346	0.837	1440
Iron Plate (t = 0.794 x 10^{-3} m)	53.7	0.461	7850[b]
Gravel	0.727	0.921	1920[b]
Brick	0.277[c]	0.879[d]	2130
Concrete	0.277[c]	0.879[d]	2130
Air	0.0277	1.01	1.15[e]

[a]Knox, R.E. 1963. Insulation properties of fluorcarbon expanded rigid urethane foam. Trans. ASHRAE, Vol. 69, p. 150.

[b]Kent, R.T. 1946. Kent's Mechanical Engineer's Handbook, 11th Ed., John Wiley & Sons, Inc.

[c]Maeda, S., Ed. 1978. Kagakukogaku Binran, 4th Ed., p. 65, Maruzen.

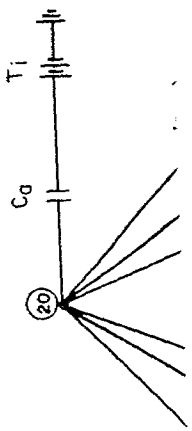
[d]Maeda, S., Ed. 1978. Kagakukogaku Binran, 4th Ed., p. 81, Maruzen.

[e]Holeman, J.P. 1972. Heat Transfer. McGraw-Hill Book Co.

Three simulation factors; the time factor, capacitance factor, and resistance factor must be specified. These three factors have two degrees of freedom and therefore, after choosing two of the factors, the third may be obtained from the following relationship:

$$TF = CF \times RF \qquad (1)$$

where TF, CF and RF are the time factor, capacitance factor and resistance factor respectively. Each of the above factors express the ratio between the



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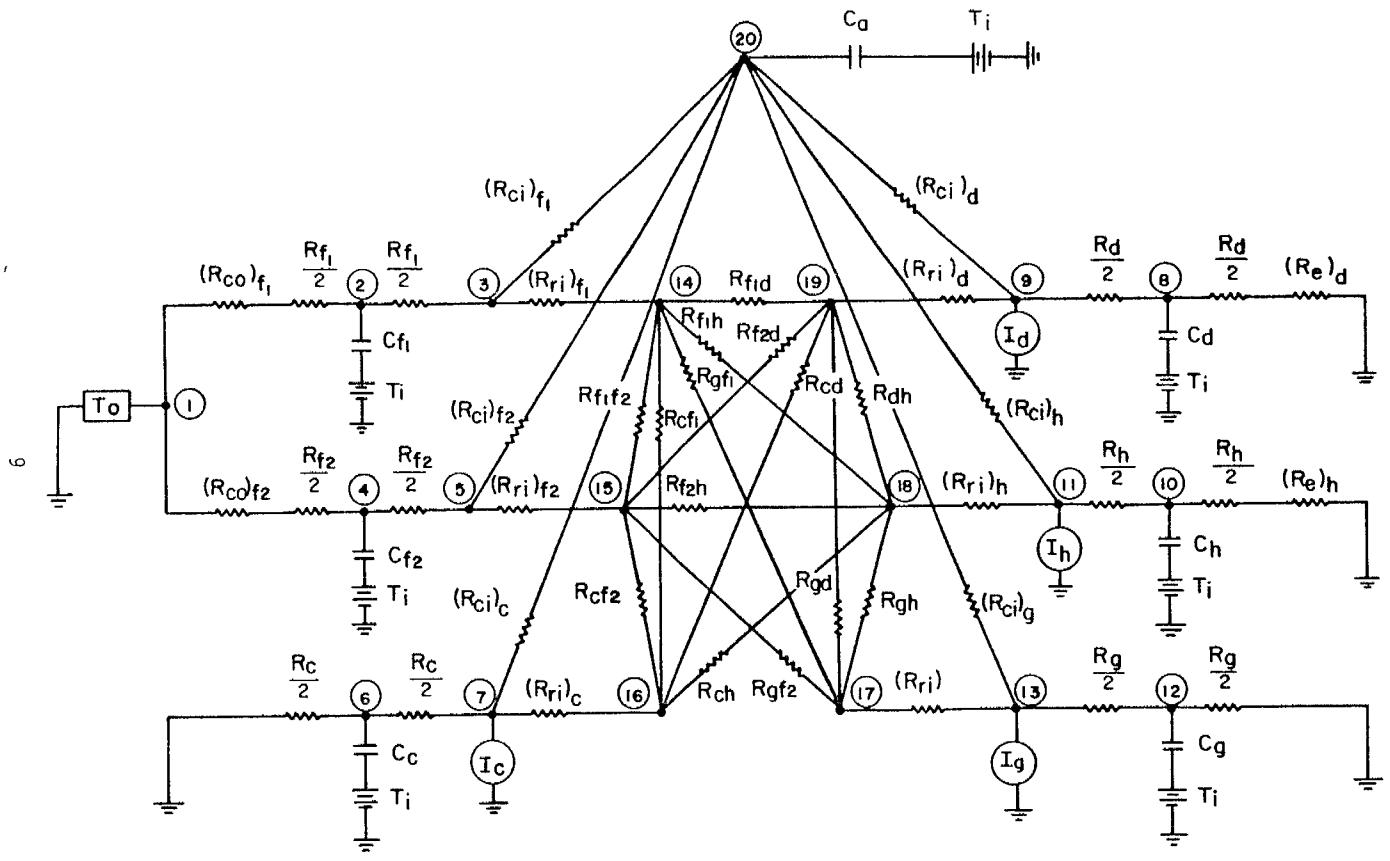

Fig. 2. Thermal network simulation model for main part.

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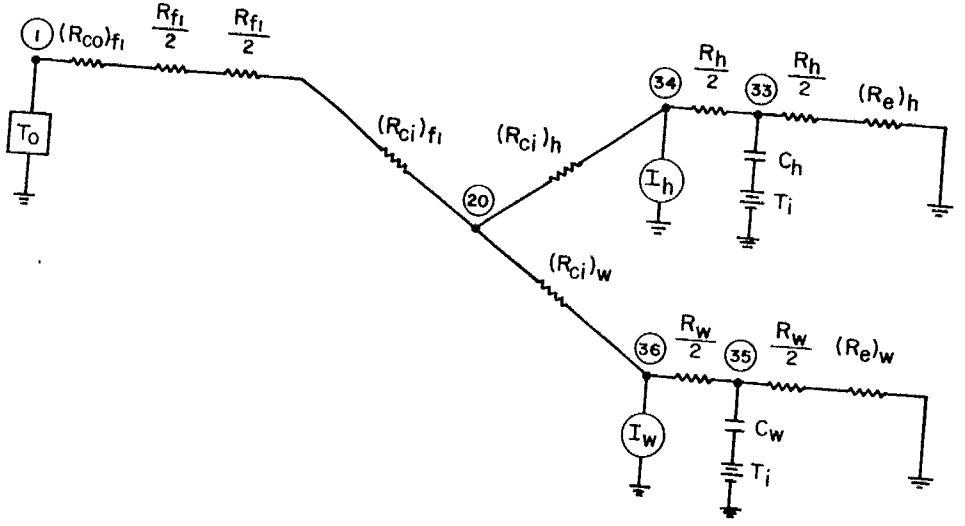

Fig. 3. Thermal network simulation model for upper east.

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Fig. 3. Thermal network simulation model for upper east.

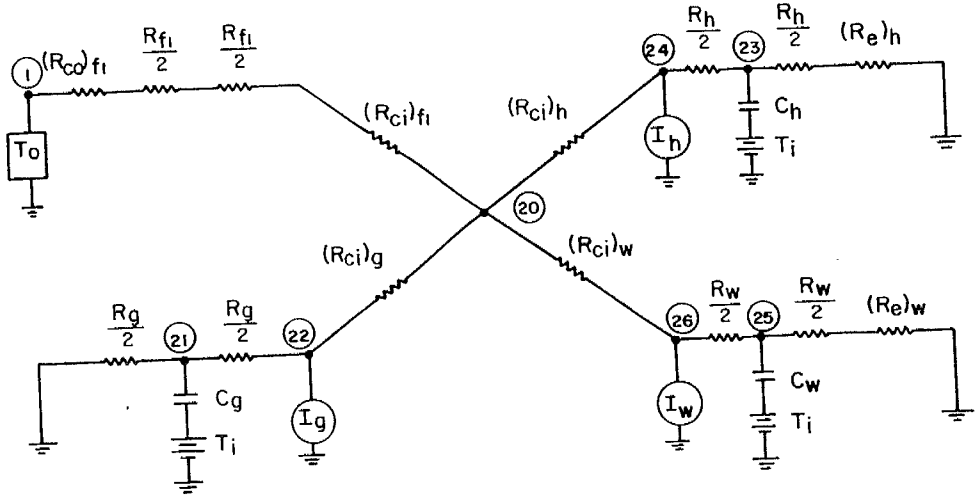

Fig. 4. Thermal network simulation model for lower east.

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model value and the physical system value of their respective parameters as given in the following relationship:

$$TF = \frac{\theta_e}{\theta_t},\ CF = \frac{C_e}{C_t},\ RF = \frac{R_e}{R_t} \qquad (2)$$

where θ_e and θ_t are the modeling time and actual time, C_e and C_t are electrical capacitance and actual system thermal capacity, and R_e and R_t are the electrical resistance and the system thermal resistance.

A scale factor had to be chosen for the voltage and current. With an arbitrary choice of a scale factor for either voltage or current, the other scale factor may be calculated from the following relationships:

$$VF = IF \times RF \qquad (3)$$

where VF, IF and RF are the voltage factor, current factor and resistance factor respectively. Units and scale factors of analogous electrical and thermal parameters are shown in Table 3.

The calculation procedures in the analysis can be summarized by the following successive steps using the south vertical fiberglass as an example.

A thermal conduction resistance is calculated from the following equation;

$$R_t = \frac{L}{K_t A}\left(\frac{^\circ C}{J/s}\right) \qquad (4)$$

where

L = length of the conductor (m)

K_t = thermal conductivity (J/(s·m·°C))

A = cross-sectional area, (m^2)

For the vertical fiberglass wall, $L = 1.016 \times 10^{-3}$ (m), $A_{f2} = 22.16$ (m^2) and $K_t = 0.0346$ (J/(s·m·°C)).

$$(R_{f2})_t = \frac{1.016 \times 10^{-3}}{0.0346 \times 22.16} = 13.25 \times 10^{-4}\left(\frac{^\circ C}{J/s}\right) \qquad (5)$$

From Table 3 the value of resistance scale factor is 8×10^6.

$$R_{f2} = 13.25 \times 10^{-4} \times 8 \times 10^6 = 10.60 \times 10^3\ (\Omega) \qquad (6)$$

TABLE 3. U
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Thermal Qua

Time

Capacity

Resistance

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where

c_p = un

γ = de

V = vo

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TABLE 3. UNITS AND SCALE FACTORS OF ANALOGOUS ELECTRICAL AND THERMAL PARAMETERS.

Thermal Quantity	Electrical Units	Scale Factor Ratio	Scale Factor Value
Time	Second	$\frac{\Theta_e}{\Theta_t}$	1
Capacity	Farad	$\frac{C_e}{C_t}$	1.25×10^{-7}
Resistance	ohm	$\frac{R_e}{R_t}$	8×10^{8}
Potential (Temperature)	Volt	$\frac{V}{T}$	1
Rate of Energy Transfer	Ampere	$\frac{A}{I}$	1.25×10^{-7}

A thermal capacitance is calculated from the following equation:

$$C_t = c_p \gamma V \ (J/^oC) \qquad (7)$$

where

c_p = unit heat capacity (J/(kg·°C))

γ = density (kg/m^3)

V = volume of the mass (m^3)

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For the vertical fiberglass wall

$$(C_{f2})_t = 0.837 \times 10^3 \times 1440 \times 1.016 \times 10^{-3} \times 22.16 = 22.136 \times 10^3 \ (J/°C) \quad (8)$$

$$C_{f2} = 27.136 \times 10^3 \times 1.25 \times 10^{-7} = 3.392 \times 10^{-3} \ (F) \quad (9)$$

A convection resistance for a particular surface is defined by $1/(h_c A)$ in which h_c is the convection coefficient. The thermal convection coefficient between the exposed surfaces and the outside air, h_{co}, is influenced by the air velocity over the surface. The outside convection coefficient for a wind velocity of 4.0 m/s on the experiment day is

$$h_{co} = 21.52 \ (J/(s \cdot m^2 \cdot °C)) \quad (10)$$

For the vertical fiberglass the outside convection resistance can be calculated as

$$((R_{co})_{f2})_t = \frac{1}{21.52 \times 22.16} = 2.097 \times 10^{-3} \ \left(\frac{°C}{J/s}\right) \quad (11)$$

$$(R_{co})_{f2} = 2.097 \times 10^{-3} \times 8 \times 10^6 = 1.678 \times 10^4 \ (\Omega) \quad (12)$$

The inside resistance can be estimated based on free convection considering there was no obvious air movement inside the greenhouse assuming air velocity was 0.06 m/s. The convection coefficient h_{ci} was estimated as

$$h_{ci} = 5.849 \ (J/(s \cdot m^2 \cdot °C)) \quad (13)$$

The inside convection resistance was calculated as follows

$$((R_{ci})_{f2})_t = \frac{1}{5.849 \times 22.16} = 7.715 \times 10^{-3} \ \left(\frac{°C}{J/s}\right) \quad (14)$$

$$(R_{ci})_{f2} = 7.715 \times 10^{-3} \times 8 \times 10^6 = 6.172 \times 10^4 \ (\Omega) \quad (15)$$

Radiation exchange network accounting for direct radiation of the collector and the radiation between surfaces within the solar collector was calculated based on Eq. (16). The shape factors, F_{in}, required to evaluate the network resistors were computed with reference equations and charts. The values of surface emissivity, ϵ, used in the calculation are 0.95 for the furnace room south walls and roof and for the top air duct, and 0.7 for the

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concrete floor and black walls and gravel. An average surface temperature, T_{av}, of 305.4 K and the Stefan-Boltzman constant, σ, of 5.569×10^{-8} $J/(K^4 \cdot m^2 \cdot s)$ are used in the evaluation of resistance. The inside surface radiation resistance for the vertical fiberglass is calculated as follows:

$$((R_{ri})_{f2})_t = \frac{1-\epsilon}{4A_{f2}\epsilon\sigma T_{av}^3} \qquad (16)$$

$$= \frac{0.05}{4 \times 22.16 \times 0.95 \times 5.669 \times 10^{-8} \times (305.4)^3}$$

$$= 3.677 \times 10^{-4} \quad \left(\frac{^\circ C}{J/s}\right)$$

$$(R_{ri})_{f2} = 3.677 \times 10^{-4} \times 8 \times 10^6 = 2.942 \times 10^3 \ (\Omega) \qquad (17)$$

A direct radiation resistance and the equivalent electric resistance between surfaces f2 (vertical fiberglass) and g (gravel) can be calculated respectively as follows:

$$(R_{f2g})_t = \frac{1}{4 A_g F_{in} \sigma T_{av}^3}$$

$$= \frac{1}{4 \times 18.14 \times 0.09896 \times 5.669 \times 10^{-8} \times (305.4)^3}$$

$$= 8.624 \times 10^{-2} \quad \left(\frac{^\circ C}{J/s}\right) \qquad (18)$$

$$R_{f2g} = 8.624 \times 10^{-2} \times 8 \times 10^6 = 6.899 \times 10^5 \ (\Omega) \qquad (19)$$

The calculated values of the conduction resistances and capacitances for the component are summarized in Tables 4 and 5, respectively. The summarized results for convection and radiation resistances are respectively shown in Tables 6 and 7.

Results and Discussion

During the course of simulating the greenhouse thermal behavior and measuring the solar-generated heat sources and temperatures, it was found that

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TABLE 4. CONDUCTION RESISTANCES FOR COLLECTOR COMPONENTS.

Main Part		Lower Part	
$\frac{R_{f1}}{2}$	$= 1.092 \times 10^3$	$\frac{R_{f1}}{2}$	$= 1.753 \times 10^4$
$\frac{R_{f2}}{2}$	$= 5.300 \times 10^3$	$\frac{R_g}{2}$	$= 1.302 \times 10^6$
$\frac{R_c}{2}$	$= 1.910 \times 10^4$	$\frac{R_h}{2}$	$= 2.824 \times 10^5$
$\frac{R_d}{2}$	$= 2.514$	$\frac{R_w}{2}$	$= 7.348 \times 10^5$
$\frac{R_g}{2}$	$= 1.611 \times 10^5$	Upper Part	
$\frac{R_h}{2}$	$= 3.791$	$\frac{R_{f1}}{2}$	$= 1.716 \times 10^4$
		$\frac{R_h}{2}$	$= 8.949$
		$\frac{R_w}{2}$	$= 4.378 \times 10^6$

TABLE 5.

Main Part

C_{f1} = 1.64

C_{f2} = 3.39

C_c = 1.77

C_d = 8.45

C_g = 2.35

C_h = 5.60

TABLE 6.

Main (Rc

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TABLE 5. CAPACITORS FOR COLLECTOR COMPONENTS.

Main Part		Lower Part	
C_{f1}	$= 1.647 \times 10^{-2}$	C_g	$= 2.918 \times 10^{-1}$
C_{f2}	$= 3.392 \times 10^{-3}$	C_h	$= 1.519 \times 10^{-1}$
C_c	$= 1.772$	C_w	$= 5.838 \times 10^{-2}$
C_d	$= 8.451 \times 10^{-3}$	Upper Part	
C_g	$= 2.359$	C_h	$= 2.374 \times 10^{-3}$
C_h	$= 5.603 \times 10^{-3}$	C_w	$= 9.798 \times 10^{-3}$

TABLE 6. INSIDE AND OUTSIDE CONVECTION RESISTANCES.

		Inside Convection Resistance		
Main	$(R_{ci})_{f1}$	$= 1.271 \times 10^4$	Lower $(R_{ci})_{f1}$	$= 2.041 \times 10^5$
	$(R_{ci})_{f2}$	$= 6.172 \times 10^4$	$(R_{ci})_g$	$= 6.095 \times 10^5$
	$(R_{ci})_c$	$= 2.583 \times 10^4$	$(R_{ci})_h$	$= 2.374 \times 10^5$
	$(R_{ci})_g$	$= 7.534 \times 10^4$	$(R_{ci})_w$	$= 6.178 \times 10^5$
	$(R_{ci})_d$	$= 5.813 \times 10^4$		
	$(R_{ci})_h$	$= 8.768 \times 10^4$	Upper $(R_{ci})_{f1}$	$= 1.998 \times 10^5$
			$(R_{ci})_w$	$= 3.681 \times 10^5$
			$(R_{ci})_h$	$= 2.070 \times 10^5$
		Outside Convection Resistance		
Main	$(R_{co})_{f1}$	$= 3.455 \times 10^3$	Lower $(R_{co})_{f1}$	$= 5.551 \times 10^4$
	$(R_{co})_{f1}$	$= 1.678 \times 10^4$	Upper $(R_{co})_{f1}$	$= 5.430 \times 10^4$

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TABLE 7. INSIDE RADIATION EXCHANGE NETWORK RESISTANCES IN MAIN PART.

$(R_{ri})_{f1}$	$= 6.057 \times 10^2$	R_{f1h}	$= 9.922 \times 10^4$
$(R_{ri})_{f2}$	$= 2.941 \times 10^3$	R_{f2c}	$= 2.368 \times 10^5$
$(R_{ri})_{c}$	$= 1.002 \times 10^4$	R_{f2d}	$= 9.804 \times 10^5$
$(R_{ri})_{d}$	$= 2.770 \times 10^3$	R_{f2g}	$= 6.899 \times 10^5$
$(R_{ri})_{g}$	$= 2.926 \times 10^4$	R_{f2h}	$= 3.992 \times 10^6$
$(R_{ri})_{h}$	$= 4.178 \times 10^3$	R_{cd}	$= 4.374 \times 10^5$
R_{f1f2}	$= 8.163 \times 10^4$	R_{ch}	$= 3.043 \times 10^5$
R_{f1c}	$= 3.124 \times 10^4$	R_{gd}	$= 1.797 \times 10^6$
R_{f1d}	$= 5.255 \times 10^4$	R_{gh}	$= 8.820 \times 10^5$
R_{f1g}	$= 8.775 \times 10^4$	R_{hd}	$= 5.012 \times 10^6$

the numbers of time varying voltage and current sources exceed the circuit size limitations of five each for PCAP. Therefore, in forming the network models for the greenhouse solar system, the input sources were divided into two groups, with one group considering concrete floor, gravel, top duct, furnace room south wall and other group considering furnace room (except south wall) and connecting north wall, to overcome the size limitations. Figure 5 shows the PCAP simulation programs for the first group on the left and the second group on the right. Figures 6 and 7 respectively show the computer plots for the first and the second group. The resulting responses of these two groups were replotted and added together based on the principle of superposition to obtain the total system response which compares favorably with the measured data as shown in Fig. 8. The measured outside air temperatures, total and diffuse solar radiation has also been plotted in Fig. 8, because the solar radiation and outside temperature are major input sources of the system. The simulation results indicated the major air temperature rise in the greenhouse is caused by concrete floor, gravel, top duct and furnace room south wall. The air temperature rise caused by the remainder was relatively small showing maximum value of 5°C. Simulated and measured wall temperature of lower east part are shown in Fig. 9. The predicted result describes major change of wall temperature suggesting the high flexibility of this analysis. The predicted curves of temperature are in good agreement with the measured data.

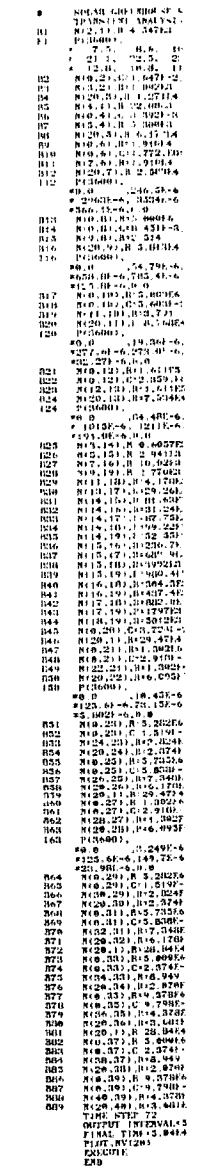

Fig. 5. PCA
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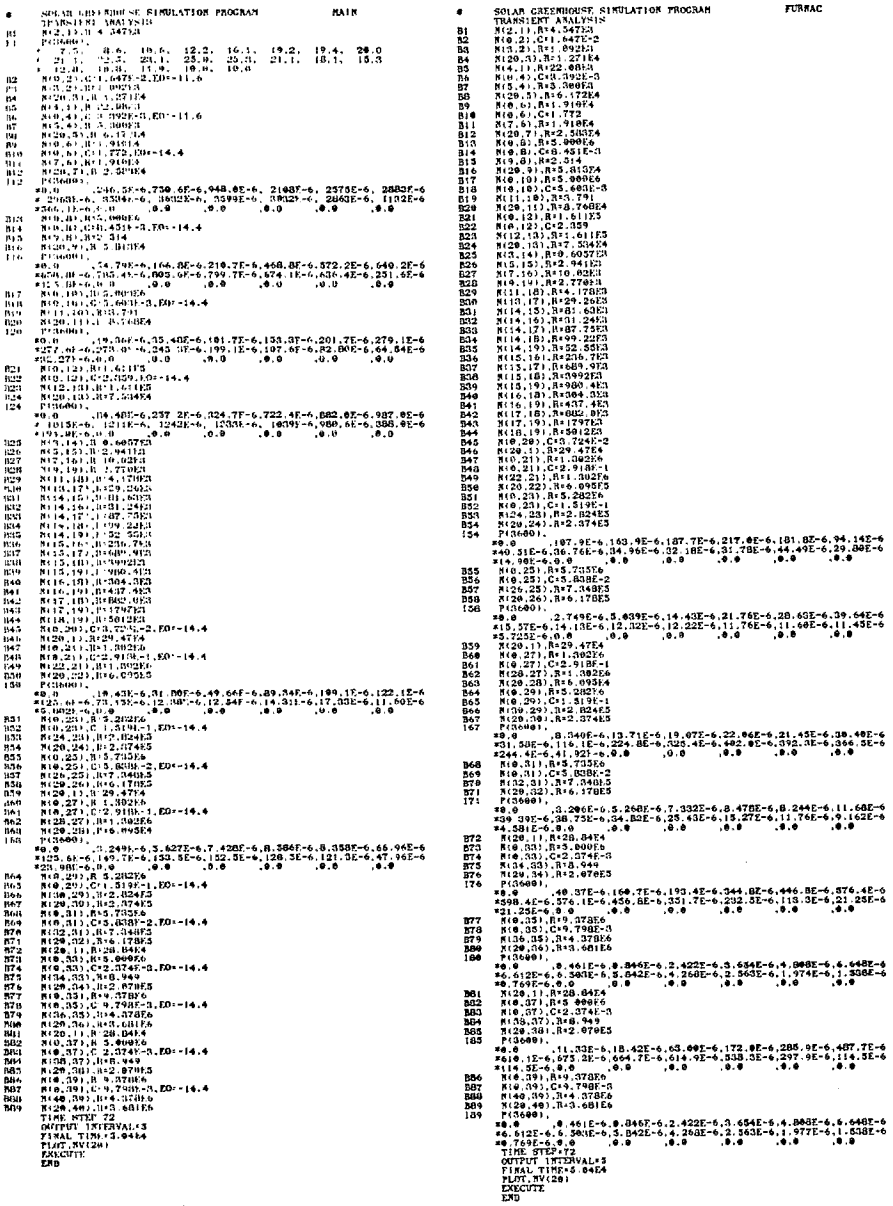

```
*   SOLAR GREENHOUSE SIMULATION PROGRAM              MAIN
    TRANSIENT ANALYSIS
B1      N(2,1),R=4.54733
B2      N(8,2),C=1.447E-2
B3      P(3600),
        7.5,    8.6,   10.6,   12.2,   14.1,   16.2,   19.4,   20.0
        21.1,   22.5,   23.1,   23.9,   23.9,   23.1,   18.1,   15.3
        12.8,   10.8,   11.9,   10.6,   10.0
B4      N(9,2),C=1.447E-2,E0=-11.6
B5      N(5,2),R=.09213
B6      N(20,3),R=1.27E4
B7      N(4,1),R=2.98E-3
B8      N(10,4),C=3.892E-3,E0=-11.6
B9      N(5,4),R=3.806E3
B10     N(9,3),R=6.17E4
B11     N(7,6),R=1.919E4
B12     N(20,7),R=2.503E4
B13     N(9,6),R=5.000E6
B14     N(9,8),C=8.451E-3
B15     N(9,8),R=2.5+4
B16     N(20,9),R=3.813E4
B17     N(8,10),R=5.000E6
B18     N(10,10),C=5.680E-3
B19     N(11,10),R=3.791
B20     N(20,11),R=8.768E4
B21     N(8,12),R=1.611E3
B22     N(10,12),C=2.359
B23     N(12,13),R=1.611E3
B24     N(20,13),R=7.534E4
B25     N(3,14),R=9.605E3
B26     N(5,15),R=2.941E3
B27     N(7,16),R=10.02E3
B28     N(9,14),R=2.778E3
B29     N(11,16),R=4.178E3
B30     N(13,17),R=29.26E3
B31     N(14,17),R=87.75E3
B32     N(14,18),R=99.22E3
B33     N(14,19),R=32.55E3
B34     N(15,16),R=216.7E3
B35     N(13,17),R=889.9E3
B36     N(15,18),R=999E3
B37     N(15,19),R=900.4E3
B38     N(16,18),R=364.3E3
B39     N(16,19),R=437.4E3
B40     N(17,18),R=882.8E3
B41     N(17,19),R=1797E3
B42     N(18,19),R=5012E3
B43     N(8,20),C=3.724E-2
B44     N(20,1),R=29.47E4
B45     N(8,21),R=1.392E6
B46     N(8,21),C=2.918E-1,E0=-14.4
B47     N(22,21),R=1.392E6
B48     N(20,22),R=6.095E5
B49     N(8,23),R=5.282E6
B50     N(8,23),C=1.519E-1,E0=-14.4
B51     N(24,23),R=2.824E5
B52     N(20,24),R=2.374E5
B53     N(25,24),R=7.340E5
B54     N(26,25),R=6.178E5
B55     N(8,27),C=2.918E-1,E0=-14.4
B56     N(28,27),R=1.392E6
B57     N(20,28),R=6.095E4
B58     P(3600),
        .249E-6,5.627E-6,7.426E-6,8.386E-6,8.358E-6,6.66.9E-6
        125.6E-6,149.7E-6,152.5E-6,132.5E-6,126.3E-6,121.3E-6,47.96E-6
        28.98E-6,0.0,      .0,      .0,      .0,      .0,      .0
B59     N(8,29),R=5.282E6
B60     N(8,29),C=1.519E-1,E0=-14.4
B61     N(30,29),R=2.824E5
B62     N(20,30),R=2.374E5
B63     N(8,31),R=5.735E6
B64     N(8,31),C=5.838E-2,E0=-14.4
B65     N(32,31),R=7.340E5
B66     N(20,32),R=6.178E5
B67     N(8,33),C=2.374E-3,E0=-14.4
B68     N(34,33),R=8.944
B69     N(20,34),R=2.078E5
B70     N(8,35),R=9.379E6
B71     N(36,35),R=4.379E6
B72     N(20,36),R=3.681E6
B73     P(3600),
        .11.33E-6,18.42E-6,63.66E-6,172.8E-6,285.9E-6,487.7E-6
        610.1E-6,673.3E-6,664.7E-6,614.9E-6,533.3E-6,297.9E-6,114.5E-6
        114.5E-6,0.0,      .0,      .0,      .0,      .0,      .0
B74     N(4,39),R=9.378E6
B75     N(9,39),C=9.798E-3
B76     N(40,39),R=4.378E6
B77     N(20,40),R=3.681E6
B78     P(3600),
        .0,      .0,      .0,      .0,      .0,      .0,      .0
        .0,      .0,      .0,      .0,      .0,      .0,      .0
        .0,      .0,      .0,      .0,      .0,      .0,      .0
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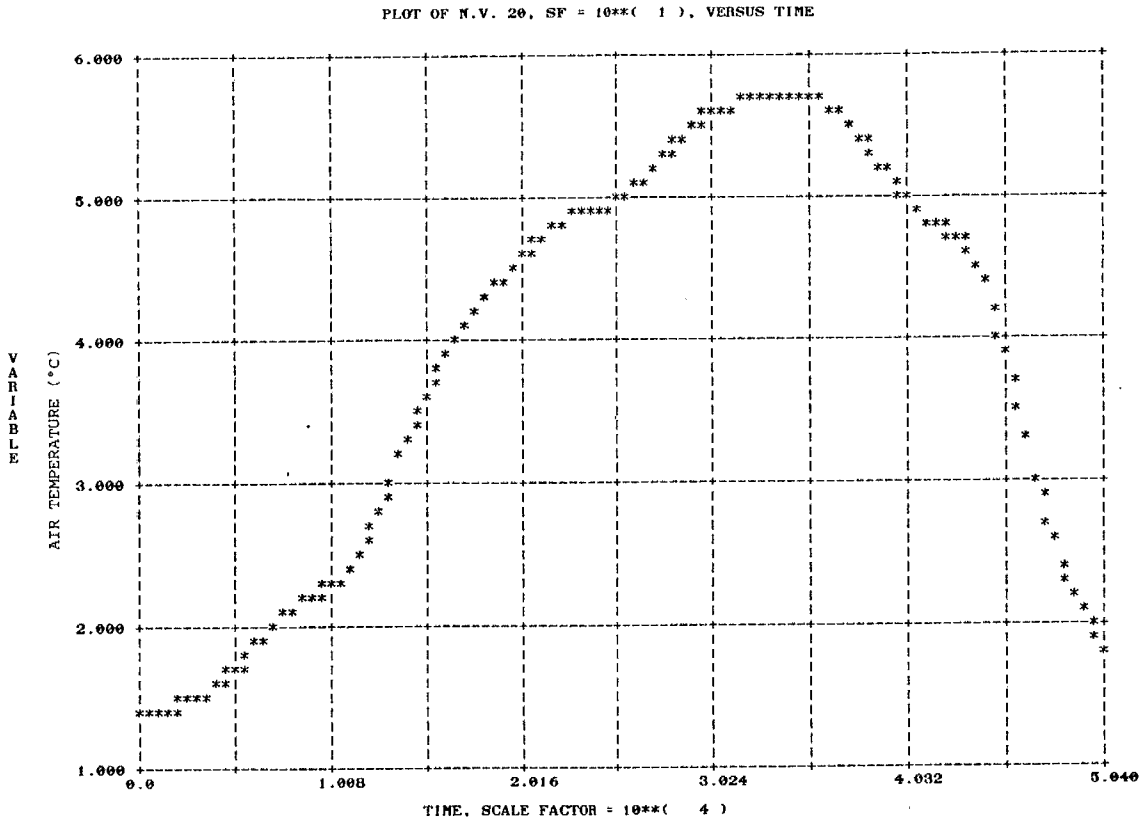

Fig. 6. Computer plot for left program in Fig. 5.

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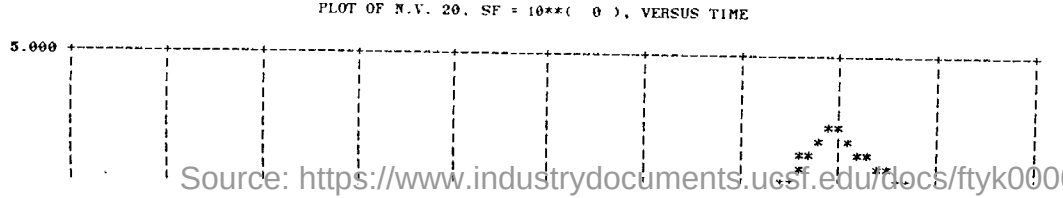

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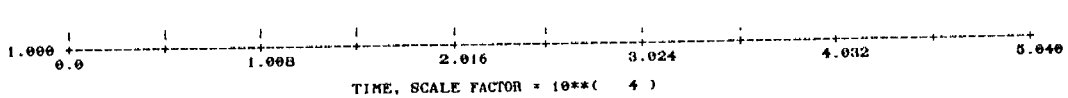

Fig. 6. Computer plot for left program in Fig. 5.

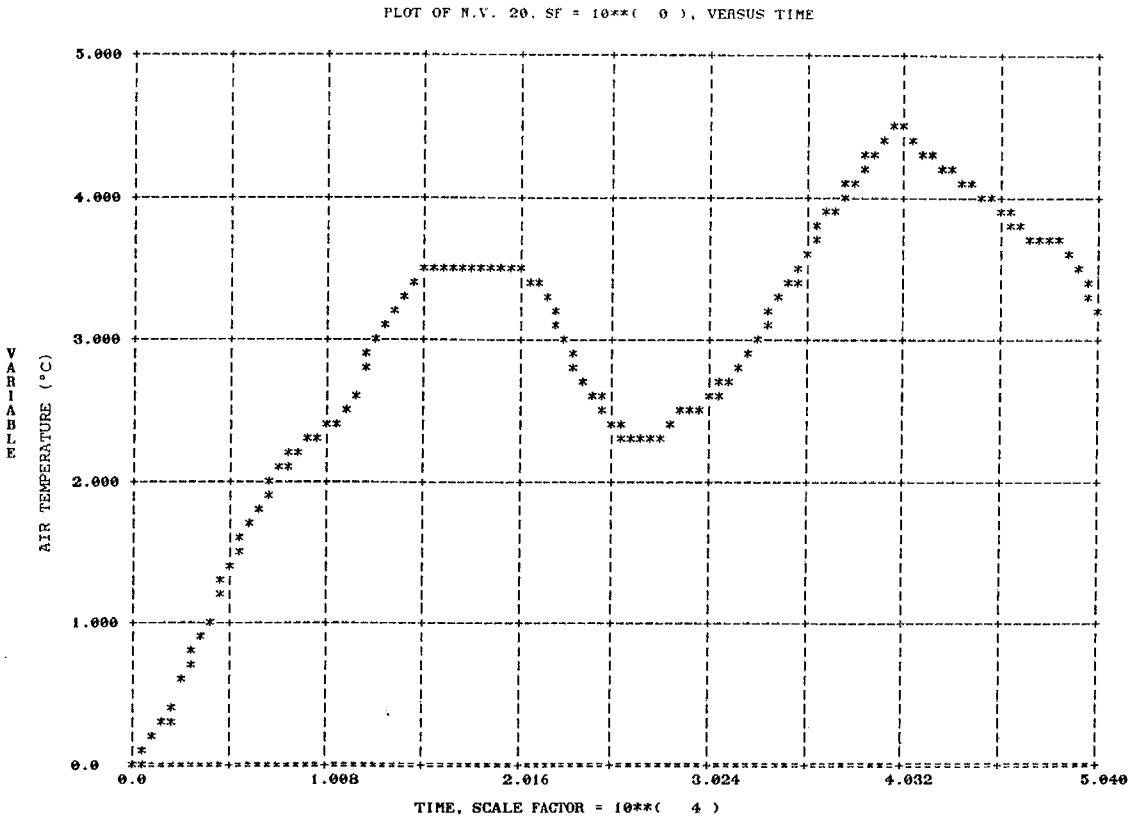

Fig. 7. Computer plot for right program in Fig. 5.

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Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

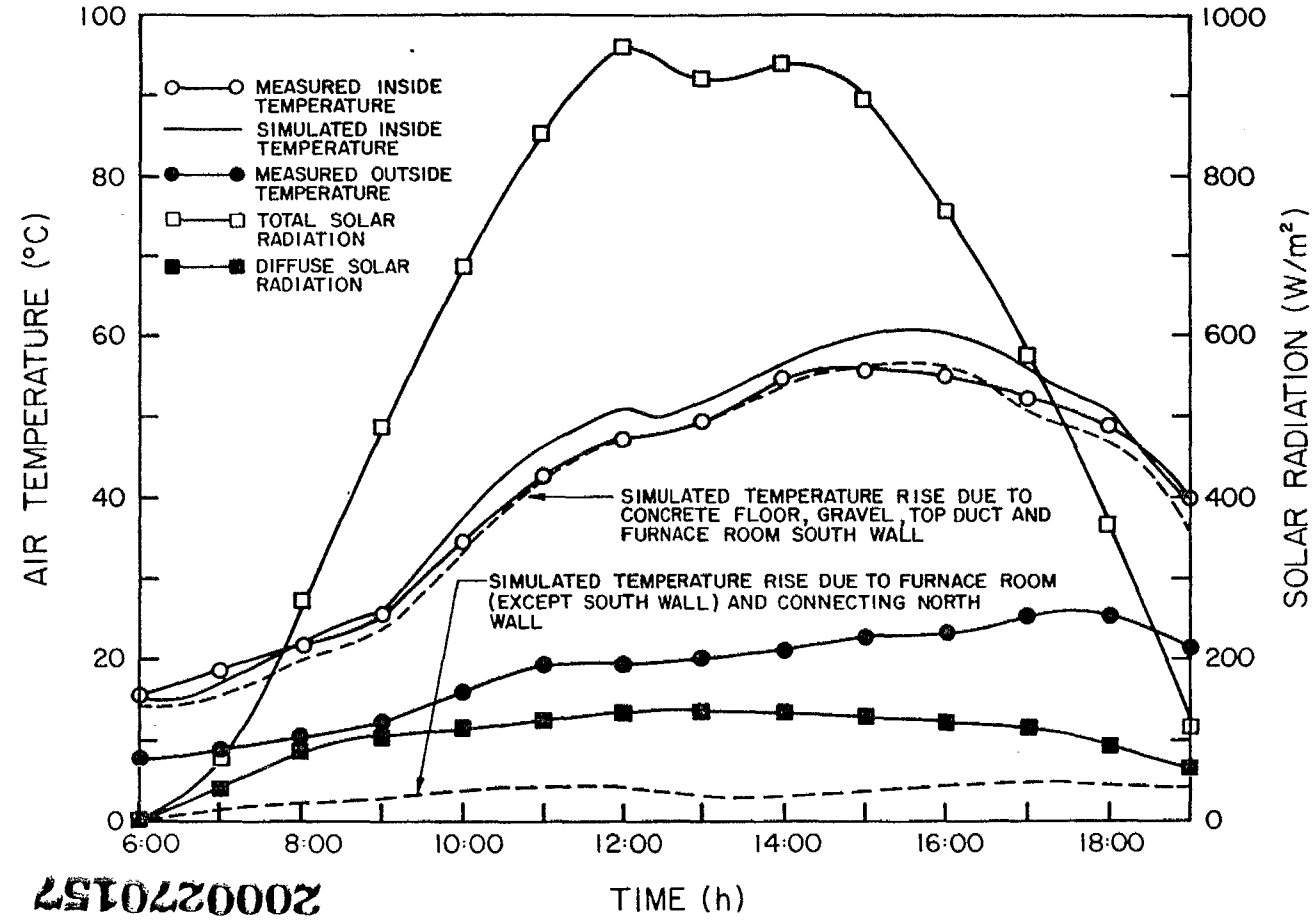

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Fig. 8. Solar radiation, outside and inside air temperatures, and measured and predicted air

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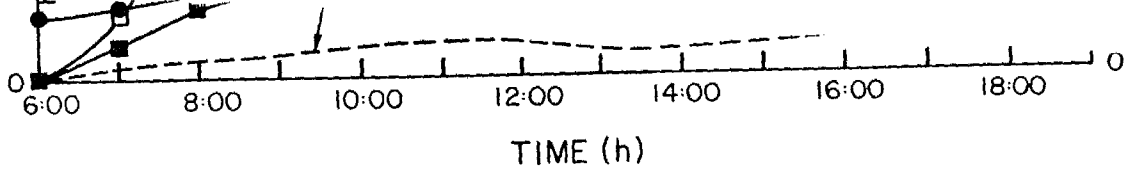

Fig. 8. Solar radiation, outside and inside air temperatures, and measured and predicted air

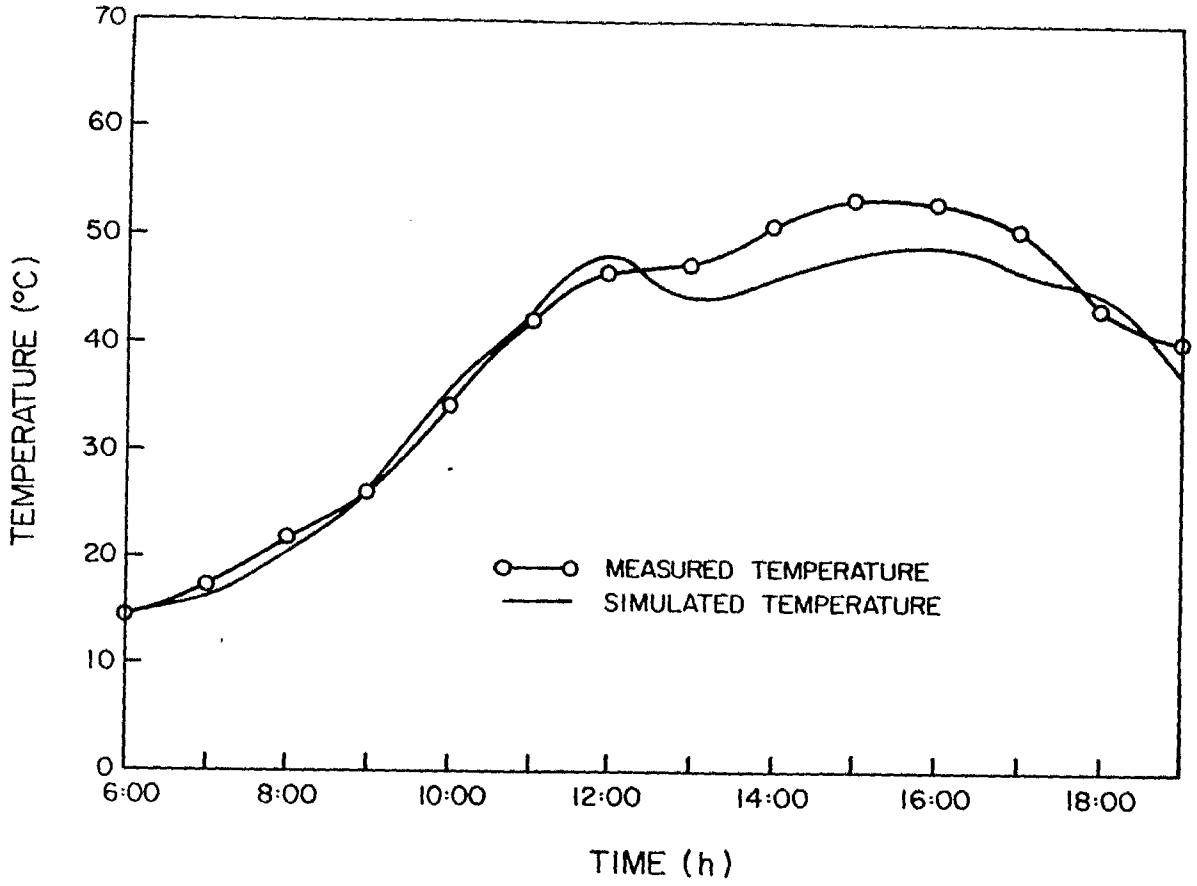

Fig. 9. Measured and simulated temperatures for north wall (lower east).

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The digital simulation analysis described in this paper has demonstrated high degree of flexibility and economy in the rapid and quantitative determination of varible interactions on the behavior of a complex thermal system. The thermal network provides the total system picture and quantitative estimation on the greenhouse system.

II. Graduate Students in Tobacco Related Research:

None

III. Post-Doctoral Fellows and Visiting Scholars:

None

IV. Publications:

Huang, B.K. and A. Kato. 1985. Effects of container types on germination and seedling growth. Proc. SNA Research Conf., Atlanta, GA, 30:79-85.

Huang, B.K. and C.S. Chang. 1985. Effects of N-P-K level on tobacco seedlings grown in BR-8. Proc. SNA Research Conf., Atlanta, GA, 30:87-90.

Huang, B.K. 1985. Solar curing and drying system. Patent No. 1284610. Japan Patent Bureau, Tokyo, Japan, Oct. 9, 1985.

Huang, B.K. and M. Toksoy. 1985. Thermal analysis of a greenhouse solar curing and drying system. Proc. International Symposium on Thermal Application of Solar Energy. Hakone, Japan, p. 497-502.

Chao, A.C., B.K. Huang and F. Ai. 1985. Computer simulation of sludge dewatering and drying in a greenhouse solar system. Proc. International Symposium on Thermal Application of Solar Energy. Hakone, Japan, p. 509-514.

Chao, A.C., B.K. Huang and J.S.J. Wang. 1985. Method and apparatus for drying and handling sludge. Patent No. 4,492,039. United States Patent Office, Washington, D.C., Jan. 8, 1985.

Huang, B.K., M. Toksoy and Y.A. Cengel. 1984. Latent heat storage helps solar greenhouses. Greenhouse Grower, Dec. 1984, p. 33-37.

V. Manuscripts Accepted for Publication:

Behroozi-Lar, M., B.K. Huang and H.D. Bowen. Circuit simulation of soil temperature profile.

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VI. Manuscripts in Review:

Huang, B.K. and N.M. El-Shaik. Simulation analysis of greenhouse solar drying system for peanuts and grains.

Huang, B.K., M. Toksoy and Y.A. Cengel. Transient response of latent-heat storage in greenhouse solar system.

Huang, B.K. and C.G. Bowers, Jr. Development of greenhouse solar system for bulk tobacco curing and plant production.

Huang, B.K. and H.S. Chang. Circuit simulation analysis of heat transfer effect in solar drying.

Huang, B.K., C.S. Su, R. Takeuchi and Y.R. Chen. Noise attenuation characteristics of plant systems.

VII. Papers Presented at Professional Meetings:

Huang, B.K. 1985. Growth performance of transplants from selected culturing trays and conventional plantbed. 31st Tobacco Workers' Conf., Pinehurst, N.C., Jan. 7-10, 1985.

Huang, B.K. 1985. Latent heat storage system design in solar barn. 31st Tobacco Workers' Conf., Pinehurst, N.C., Jan. 7-10, 1985.

Huang, B.K. and M. Toksoy. 1985. Thermal analysis of a greenhouse solar curing and drying system. International Symposium on Thermal Application of Solar Energy. Hakone, Japan, Apr. 7-10, 1985.

Chao, A.C., B.K. Huang and F. Ai. 1985. Computer simulation of sludge dewatering and drying in a greenhouse solar system. International Symposium on Thermal Application of Solar Energy. Hakone, Japan, Apr. 7-10, 1985.

Song, A., B.K. Huang and H.D. Bowen. 1985. Simulating a powered model wheel-tractor on soft ground. ASAE 1985 Summer Meeting, East Lansing, MI, June 23-26, 1985.

Huang, B.K. 1985. Effects of container types on germination and seedling growth. 1985 Southern Nurserymen's Association Research Workers' Conf., Atlanta, GA, Aug. 1-4, 1985.

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Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

Title: NC03801 Improved Systems for Transplant Production and Direct Seeding of Tobacco

Project Leaders: C. W. Suggs and S. C. Mohapatra

I. Summary of Research:

A. FIELD TRIALS ON MECHANIZED TRANSPLANT PRODUCTION

This research was conducted in two parts: one part at the Lower Coastal Plains Tobacco Research Station, Kinston, NC, and the other part at the Central Crops Research Station, Clayton, NC. Experimental variables tested were: seeding methods, seed treatments, and plantbed water levels, transplant size, clipping and undercutting, bare root vs. potted plants, plantbed covers, transplant uniformity vs. root modification, etc.

Seeding Methods: As in previous years, use of pelleted seeds gave two-dimensional control on spacing while fluid-drilling gave only one dimensional control, i.e., across the bed. On the contrary, the latter gave better germination percentage than the former, perhaps because of negative effect of the pelletization procedure on germination. Pelleted seeds used in this study were, however, better than those used in previous years as a result of proprietary improvements in the pelletization method by the Royal Sluis Company, the collaborator in this study.

Seed Biotechnology: This research consists of laboratory treatments to improve seed performance under both favorable and adverse conditions. Each treatment is designed to achieve a specific objective. Thus, the dark preincubation (DPI) treatment was designed to improve transplant uniformity through improved germination synchrony, and was studied as a repeat of the previous year. This year's results were similar to those reported for last year, thus confirming that the DPI treatment improves transplant uniformity and holds promise for practical application.

Treatments for germination advancement were designed to bypass adverse weather conditions by delaying the seeding date. However, delay in seeding is likely to delay transplant availability. If seeds can be pregerminated in the laboratory prior to seeding, late seeding will be possible without delaying transplant availability. preliminary results indicate that seeds can be pregerminated for 72 hours prior to seeding through fluid drilling. However, if pelleted seeds are used, pregermination can be given for only 48 hours, because treated seeds need to be dried for pelletization, and research in previous years has shown that drying after 72 hours of imbibition results in the loss of seed viability. A major problem associated with the use of pregerminated seeds is seed waste if they can not be used immediately following germination advancement because of inclement weather. Thus further improvements in seed biotechnology are needed for preservation without loss of viability and/or vigor of pregerminated seeds. Future research will be directed to achieve this objective.

Plantbed Water Level: According to the current procedure, the plantbed is saturated with water (about 1/2" water) followed by covering with a solid

plastic cover. Thu
removed some time
all mechanized ope
pulled water wagon.
efficient with gre
seed germination.
full (i.e., 1/2" wa
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plastic cover. Thus, no watering becomes necessary until the solid cover is removed some time in April. Because overhead watering can not be used until all mechanized operations are complete, water is supplied through a tractor-pulled water wagon. This procedure is time consuming, but can be made more efficient with greater knowledge on the actual water requirement for tobacco seed germination. Therefore, plant beds were supplied with water to obtain full (i.e., 1/2" water), half, and one-fourth saturation. Results from this preliminary study indicate that one-fourth saturation may suffice for tobacco seed germination and early seedling development until plastic cover removal. If true, this would significantly shorten the time needed to water the plantbeds.

Transplant Size: Yield and value were not appreciably affected by transplant size, Table 1. There was a trend, however, for large seedlings to have lower yield and value. Days to flower were longer for long thin plants than for the other sizes. Sugar and alkaloids were not affected by plant size. Transplanting losses appeared to be larger for long thin plants. Plant losses were mixed with respect to plant size, being larger for medium plants than for larger or small plants. The leaf area growth rate measured at weekly intervals of long thin plants was slightly larger, but not significantly so, than for the other size plants. There was a trend for the large plants to have the lowest growth rates.

Dug Plants: In addition to pulling plants from the bed in the normal manner, plants were also dug with a 5 cm x 5 cm soil block. These plants were either planted with intact soil block or with the block removed by washing or shaking. Yield and value were not appreciably affected by any of these treatments, Table 1. Also, growth rate, days to flower, sugar and total alkaloids concentrations were not affected. Plants with washed or shaken roots appeared to have higher transplanting losses. Dug plants had the same overall range of growth rates as pulled plants. There were some minor individual differences, with medium sized dug plants with washed roots having the highest value.

Mixed Sizes: In typical tobacco production operations, transplants are selected so that large and small seedlings are not placed into the field. Plots in which 10%, 20% and 30% of both small and large plants were included with the medium size plants produced essentially the same yield and value as the check plot, Table 1. Sugar and total alkaloids concentrations were not affected. These results are of particular importance with respect to automatic feeding of transplanting equipment. A wider range of plant sizes can be used without jepordizing crop yield or value. Since smaller plants appear to flower at about the same time as larger plants (as discussed in a previous paragraph) it would appear that mechanical harvesting equipment can be used on mixed seedling size plantings. There was an increase in transplanting losses as the number of small plants increased.

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Table 1. Effect of Translant Size on Yield, Value and Other Characteristics.

Description	Yield kg/ha	Value $/Kg	Growth Rate %/day	Days to Flower	Sugar %	T. Alk. %	Transp. Losses %
Pulled Plants							
Small	2699	10279	8.93	77.5	16.0	2.40	1.2
Medium (check)	2784	10600	9.29	78.5	15.4	2.25	2.5
Large	2662	10118	7.98	75.6	15.3	2.36	1.2
Long Thin	2744	10579	10.22	81.6	15.4	2.16	3.7
Dug Plants 5 x 5 cm Block							
Small	2822	10831	8.64	74.0	15.9	2.26	1.2
Medium	2751	10508	7.87	73.0	14.6	2.28	0
Med, Washed	2731	10422	10.27	79.6	16.0	2.30	3.7
Med, Shaken	2846	10606	9.90	77.6	14.8	2.44	2.5
Mixed Sizes, Pulled							
10%S, 80%M, 10%L	2771	10558	-	-	15.3	2.22	1.2
20%S, 60%M, 20%L	2676	10277	-	-	15.4	2.25	1.2
30%S, 40%M, 30%L	2780	10688	-	-	16.0	2.20	5.0
Clipping and Undercutting							
Check	2989	11441	9.29	77.1	15.4	2.10	1.2
Clip Once	3028	11623	10.30	78.9	14.6	2.10	0
Clip Twice	3016	11597	9.63	79.9	16.6	1.94	0
Clip 3 Times	3007	11489	9.91	74.9	15.4	2.18	0
Undercut Once	2962	11284	9.88	72.5	14.6	2.00	2.5
Clip & Undercut	3047	11735	10.94	75.0	13.0	2.04	0

Clipping and Undercutting: Yield and value of plots planted from plantbeds which had been clipped 1, 2 or 3 times, undercut once or undercut and clipped were not significantly different from the check, Table 1. Clipping did not appear to appreciably affect days to flower. However, the undercut once plot appeared to flower early while the clipped plus undercut plot flowered at about the same time as the plot which had been clipped three times. There were no consistent differences in the sugar or alkaloids concentrations. Clipped plants lived extremely well but plants that had been undercut showed some losses. These differences may not be significant because of the relative small number of plants involved (20 plants/rep x 4 reps = 80 plants). There were small nonsignificant differences between the check and the clipped or undercut plants. However, no trends were evident.

Bare Root vs Potted Plants: The intact root potted treatments had yields and values that, depending on cell and plant size, were slightly but not significantly larger or smaller than the check treatment, Table 2. There was not a consistent pattern with respect to what plant or pot size produced the

Table 2. Effe
Char

Treatment
Bare Roots
Check
Agri. Gel
Intact Roots
2 cm Paper Po Med Plant
3 cm Paper Po Med Plant
4 cm Paper Po Med Plant
2 cm Paper Po Large Plant
3 cm Paper Po Large Plant
2 cm Soil Plu Med Plant
Plantbed Cover
Solid Plastic
Plus Shade, P. Removed
Replaced with Reemay
Perforated in Spring
Perforated in Late Winter
Perforated Whe Seeded
Reemay
Slit Plastic
Clear
Milk White

*Bare vs intact

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Table 2. Effect of Intact Roots and Plantbed Cover on Yield, Value and Other Characteristics.

Treatment	Yield kg/ha	Value $/ha	Growth Rate %/day	Days to Flower	Sugar %	T. Alk. %	Transp. Losses %
Bare Roots							
Check	2766	10587		65.8*	16.6	2.08	0
Agri. Gel	3026	11543	11.94	70.0	15.8	2.16	0
Intact Roots							
2 cm Paper Pot, Med Plant	2962	11234	14.17	70.5	14.5	2.20	18.8
3 cm Paper Pot, Med Plant	2512	9578	12.92	68.8	15.2	2.16	1.2
4 cm Paper Pot, Med Plant			12.06	62.2	15.0	2.09	0
2 cm Paper Pot, Large Plant			12.80	66.2	15.3	2.21	0
3 cm Paper Pot, Large Plant	2958	11268	13.52	62.8	14.8	2.36	0
2 cm Soil Plug, Med Plant	2734	10540	13.96	62.8	15.5	2.50	0
Plantbed Covers							
Solid Plastic							
Plus Shade, Plastic Removed	2999	11220	-	76.4	15.2	2.12	3.7
Replaced with Reemay	2920	10832	-	77.1	14.2	2.28	6.2
Perforated in Spring	2914	11036	-	77.5	15.0	2.29	3.7
Perforated in Late Winter	2956	11152	-	75.0	15.5	2.09	2.5
Perforated When Seeded	3012	11232	-	75.9	15.6	2.16	0
Reemay	3074	11496	-	75.4	15.7	2.14	0
Slit Plastic							
Clear	2950	11084	-	76.5	14.3	2.34	1.2
Milk White	2912	10985	-	74.3	16.3	2.20	0

*Bare vs intact root data from Clayton only.

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Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

best results. Agri-gel, placed either in the transplant water or around the plant, gave a slight increase in yield and value as compared to the check. There was some variability in the days to flower but no trends could be identified. Also, the sugar and alkaloids data did not reveal any trends. Transplanting losses were very low for all of the potted (intact root) plants except for the small (2 cm dia) paper pot grown plants. All of the intact root plants had slightly higher growth rates than any of the bare root treatments. This does not necessarily translate into higher yield and value as the growth rates, being for the first four to five weeks after transplanting, are a better measure of early growth and resistance to transplanting shock.

Plantbed Covers: While the germination, survival and uniformity of seedlings grown under different covers may vary, there were no significant differences in crop yield or value attributed to plantbed cover, Table 2. As expected, no trends were evident in days to flower, percent sugar or percent alkaloids. There were some appreciable transplanting losses associated with various bed covers, but no pattern is evident.

Transplant Uniformity and Root Modification: Tobacco plantbeds and possibly greenhouse plantings, are characterized by nonuniform growth and development. Part of the nonuniformity is due to nonsynchronous germination, but much of it develops from shading as competition for light and other growth inputs become critical. Clipping off leaf growth above the bud reduces shading and allows light to reach some of the smaller plants which are down in the canopy.

Undercutting is being evaluated as a means of increasing root mass and survival after transplanting.

Table 3 gives a series of size measurements made on clipped and undercut plants. While the results are mixed with respect to clipping, the undercut treatments appear to have a larger stem, more root mass, and more shoot mass than the control.

Table 3. Tobacco Seedling Measurements - Clayton 1985.

Treatments	Ext. Length (cm)	Stem Length (cm)	Stem Diameter (cm)	Root Weight (gm)	Shoot Weight (gm)	Shoot Root Ratio
1 normal	16.6	5.1	0.59	0.5	8.6	17.2
2 clip 1	13.1	4.2	0.58	0.6	6.5	10.8
3 clip 2	16.0	5.0	0.58	0.7	8.2	11.7
4 clip 3	15.2	5.3	0.60	0.6	6.2	10.3
5 under 1	17.6	6.3	0.63	0.9	10.8	12.0
6 under 2	16.8	4.5	0.60	1.3	8.6	6.6
7 clip 1, under 1	19.5	6.6	0.73	1.3	14.9	11.5

Summary Statement: Because of the great compensatory mechanism of tobacco, differences in transplant size, root mass and condition, leaf area, stem diameter, bed cover and root restraint do not seriously affect crop yield, value, growth rate, days to flower, percent sugar or percent total alkaloids. Transplant characteristics or history can, however, seriously affect plant

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survival immediately after transplanting. Although some of the results are mixed, small plants do not generally survive well during adverse conditions following transplanting. Many of the very small plants with intact roots died after transplanting.

These results suggest that with plants, either pulled from field beds or from with intact roots from greenhouses, need not be sorted closely with respect to size. With the size uniformity generated by clipping, it may be feasible to remove all of the plants from a plantbed or greenhouse area at one time, discard the very small and transplant the small, medium and large ones in the same field. This possibility has important implications with respect to the development of automatic feeding transplanters.

B. LABORATORY STUDIES ON SEED GERMINATION

Respiratory Physiology: It has been shown in previous years that alternate respiration plays an important role in tobacco seed germination. Inasmuch as mitochondria are the key energy producing compartments within the cell, it was of interest to extend this study to mitochondiral physiology during seed germination and seedling development. Various mitochondria isolation techniques available in the literature were evaluated for this purpose. An aqueous method consisting of Tris-Hcl buffer (pH 7.2) was found to be most suitable for the isolation and assay of tobacco seed mitochondria. This method will be used in ongoing research on respiratory physiology.

Autotrophic transition: As reported earlier, development of foliage leaf up to the fourth leaf following cotyledon expansion is crucial for tobacco seedling autotrophic transition and establishment. It has also been shown that a developmental restriction by the existing foliage on the developing foliage to appear results in an unexpected acropetal sequence of increasing leaf size, which reverses to the expected basipetal sequence following the formation and expansion of the fourth leaf. Investigations during 1985-86 revealed that leaf shape is also influenced by developmental restriction on autotrophic transition. Thus the pointed tip of the typical tobacco leaf did not appear until after the development of the fourth leaf. Because it is possible that the observed differences between the forms of the initial and subsequent leaves might also extend to differences in their function, this aspect is under further investigation.

Stress Physiology: Tobacco seeds experience four types of environmental stresses under plantbed conditions: a) cryostress due to low temperatures at the time of seeding and during seedling emergence, b) thermal stress due to high temperature during seedling growth under the plastic cover, c) anoxia due to flooding during heavy rain and/or snow resulting in oxygen depletion, and d) xeric stress due to drought following the removal of the plastic cover, or due to high salt concentrations in the plantbed. Response of tobacco seed germination to thermal stress and xeric stress has been studied in previous years. Research during 1985-86 dealt with cryostress. Preliminary results show that seeds soaked for nearly 24 hours can be frozen to -20 C without detectable effect on germination rate and percentage. However, as in other plant species and organs, the rate of freezing is more important than the

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terminal temperature per se. It appears that frozen seeds might offer an alternative procedure for seed singulation and mechanical seeding, particularly, in small areas. This will be investigated further.

C. GREENHOUSE PRODUCTION OF TOBACCO TRANSPLANTS

Research was initiated during 1985-86 on greenhouse production of tobacco transplants. This undertaking has several objectives: a) to develop mechanization procedures for the increasing number of North Carolina farmers who are resorting to greenhouse production of tobacco transplants, b) to facilitate application of biotechnology in tobacco transplant production, and c) continuous production of transplants for off-season testing of machines and mechanization procedures being developed for field production of tobaoco transplants.

A greenhouse with plastic cover has been built for the above purpose. Automation has been introduced to control watering and temperature. Its special features include curtains on both sides which are automatically lowered or raised under thermostatic control to maintain desired temperature. These operate in conjunction with automated ventilation commonly found in conventional greenhouses. The greenhouse is being tested with respect to various control parameters and will be soon used for transplant production.

II. GRADUATE STUDENTS:

1. H. S. Prasad: Stress physiology of tobacco seedling development.

III. POSTDOCTORAL FELLOW: None

IV. PUBLICATIONS:

1. Mohapatra, S. C., and W. H. Johnson. Measurement of whole seed respiration through dissolved oxygen polarography. Seed Science and Technology 13:1-10.

V. MANUSCRIPTS ACCEPTED FOR PUBLICATION:

1. Mohapatra, S. C., and W. H. Johnson. A thermogradient incubator for seed germination studies. Agronomy Journal 78:(in press).

VI. MANUSCRIPTS IN REVIEW:

1. Mohapatra, S. C., J. Arcila, W. H. Johnson, and L. A. Nelson. Improvement of tobacco seed germination synchrony through dark preincubation treatment.

2. Mohapatra, S. C., J. Arcila, and H. W. Spurr. Effect of seed disinfection on germination and protein synthesis of tobacco seeds.

VIII. PAPERS PI

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IX. Acknowledg

Research or
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was provided by
Timothy Seaboch
Sudha Ramesh, P
provided by Brer

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VIII. PAPERS PRESENTED AT PROFESSIONAL MEETINGS:

1. Mohapatra, S. C. Occurrence of alternate respiration during tobacco seedling development. Annual Meeting, American Society of Plant Physiologists, Providence, RI, June 23-28, 1986; Plant Physiol. 77(s):121.

IX. Acknowledgements:

Research on transplant germination, production and transplanting was supported by a grant from Philip Morris Tobacco Company. Technical assistance was provided by Hilton Peel, James Gore, Linda Blalock, David Williams, Timothy Seaboch, Don Eddington, Stanley Leary, Sidney Bland, Valsa Samuels, Sudha Ramesh, Prem Singh, and Tina Brunner. Secretarial assistance was provided by Brenda Mason and Ann Griffin.

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Title: NC 03804, Mechanization of Tobacco Production

Project Leaders: Rupert Watkins and C. W. Suggs

I. Summary of Research:

Curing humidity effects flue cured quality and the energy required for curing. It is generally accepted that a low humidity during leaf drying is conducive to higher quality but is more energy expensive. Higher humidity, while more energy efficient, is thought to be detrimental to final leaf quality. Extensions curing recommendations show a median humidity thought to be conducive to quality while allowing reasonable fuel efficiency.

The objective of this research was to test the effect of higher and lower humidity on both quality and efficiency. Humidities having wet bulb temperatures 10°F higher and 10°F lower than Extension's recommendations had been tested in 1984. In 1985 the range was narrowed and wet bulb temperatures 5°F higher and 5°F lower were compared to the recommended schedule.

This research was conducted at the Oxford Tobacco Research Station. Three small (six bulk rack capacity) curing barns were used. Each barn was equipped with a gas meter for fuel consumption recording and with automatic temperature controllers for both dry bulb and wet bulb temperatures.

Six cures or tests were conducted with tobacco from all stalk positions. For each test the three barns were loaded with similar tobacco on the same day. For all tests the dry bulb temperature schedule of North Carolina Extension Publication AG 101 was used with yellowing time adjusted for leaf ripeness. The same adjustment was made, however, for all three barns within each test. In each test the wet bulb temperatures of the three barns were maintained at the same level during the yellowing phase. After yellowing, the wet bulb temperature of one barn was adjusted according to AG 101. The wet bulb temperature of another barn was held at 5°F higher than that of AG 101, and that of the other barn was maintained at 5°F lower than that of AG 101. Quality was measured by the government grades of each cure and fuel consumption was taken from the gas meter readings after each cure.

The effect of humidity on leaf quality is shown in Table I. The normal, or recommended humidity, gave the highest average price for all cures, with the average of the high humidity appearing better than that of the low humidity. The normal humidity was best in four of the six cures with the high humidity being best for two cures. The low humidity was not best in any cure but was better than the normal humidity in one cure and better than the high humidity in one cure. The fuel usage was, as expected, highest for the low humidity and lowest for the high humidity.

Table I Ma

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Table I Market Prices and Fuel Consumption For Leaf Cured at Three Humidities in 1985

(Market prices in dollars per pound.)

Cure No.	Low Humidity (-5°F wb)	Normal Humidity	High Humidity (+5°F wb)
1	1.50	1.64	1.57
2	1.62	1.61	1.64
3	1.81	1.86	1.81
4	1.84	1.86	1.75
5	1.82	1.84	1.84
6	1.65	1.66	1.71
Average Price	1.70	1.74	1.72
Ave. Fuel Use (gal/acre)	388	333	326

The pattern of fuel usage was similar in the 1984 test wherein an extremely high and extremely low humidity were compared to the normal. The pattern of quality, however, was quite different, In the 1984 test the extremely low humidity was consistently (in every cure) better than the extremely high humidity, and was better than the normal humidity in two cures. The average price for all six cures was best for the normal humidity in 1984 as well as 1985.

IV. Publications:

Mechanization, Rupert W. Watkins, Tobacco Information 1986, North Carolina Ag. Extension Publication Ag-187 pp. 109-118, November 1985.

IX. Acknowledgements:

The assistance of Mr. Stanley Leary and Sidney Bland in conducting this research is greatfully acknowledged.

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Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

Title: N.C. 03804 Mechanization of Tobacco Production

Project Leaders: C.W. Suggs and R.W. Watkins

I. Summary of Research:

Automatic Feeding Transplanters

Although the project is still working on a machine for automatically feeding bare root, plantbed-grown seedlings, the inherent plant variability complicated the design. Plants grown in a regular array, such as a tray, flat or honeycomb, are much easier to machine feed. Accordingly, as a starting point, the project purchased a one-row machine designed to feed plants grown in the paper pot, honeycomb arrangement, which unfolds into a strand, Fig. 1. In this transplanter, one of a series of plant-gripping hand pairs rotates into position, closes on a plant and tears it from the strand. After further rotation, the hands open and release the plant into the open furrow. A restraining device holds the strand so that only one plant will be torn from the strand per cycle. The hands are opened and closed by bearings rolling along a circular cam.

A second automatic feeding transplanter under development by Powell Manufacturing Company was also tested on the research farm. This transplanter, Fig. 2, uses the same honeycomb plant configuration but has a different feeding and singulating mechanism. The plant strand is first engaged by a pair of rollers which feed the plants at the proper spacing to a pair of faster acceleration rollers which tear the plant from the strand and throw it into a drop chute.

The investigation of bare root plantbed grown seedlings involves a project built digger, Fig. 3, which undercuts and lifts the plants from a row in the bed and stitches them between paper tapes into a continuous strand. A transplanter, Fig. 4, was built which senses the location of the plants in the tape and regulates tape motion to a cutter which cuts plants from the tape at the required intervals. The line of plants is fed by means of a pair of downwardly inclined belts to the furrow opening. Feed is stopped when the plant stem trips a microswitch just before it is ejected into the furrow. Feed is resumed when another microswitch on the transplanter wheel makes contact after moving forward one plant space. The machine is hydraulically powered and controlled by a microswitch solenoid valve system. Sketches of both of these machines were included in last year's report but are repeated here for coordinating with the operating characteristics given in the next section.

Machine Operating Characteristics

The Powell machine was available for observation only one day. The feeding and singulating worked well but there was some blockage of plants in the free fall through the drop chute. It may be possible to correct this problem by straightening some of the curves in the chute. Because of the

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continuous rather than intermittent operation, the feeding and singulating system worked extremely well. It appears to be able to feed plants faster than the drop tube could accept them. We operated this machine at an estimated 2 to 2 1/2 plants per second.

Although the other honeycomb machine uses an intermittent opening and closing plant-handling system, it worked well at speeds up to 100 plants per min, Table 1. One desirable feature of this system is that it maintains control of the plant from the honeycomb all the way into the furrow. There was some problem getting the plants deep enough as the machine was too light to develop the traction required to open a deep furrow. Addition of dual tires reduced this problem. The feeding mechanism operated without a single miss in many of the runs for an overall average of less than 1%. There were a few doubles and a problem with plants that were not set upright. This problem was associated with the difficulty of planting as deep as desired. It was desirable to clip part of the leaf material to reduce tangling and the resulting poor feeding.

The bare root system under development by the project has potential but will require a lot more work before it becomes a field-worthy, dependable system. Plants are so variable in size, configuration, and location along the plantbed row that the feedback and sensing equipment required may not be feasible. The digger successfully lifts the plants, but the tape dispensing and sewing system did not work well. Although the transplanter control system was able to sense the presence of a plant, it could also be fooled by a leaf or piece of trash. Also, if plants were located too close together in the tape, the cutter might slice through the next plant.

Tests were run to evaluate the potential of the project designed tape fed transplanter. The machine was operated at nominal speeds of 15 and 43 plants per minute with plant spacings of approximately 24 inches, Table 2. The feed tapes were hand loaded at constant or variable spacings with broccoli plants or small twigs as tobacco plants were not available when the tests were being made. Performance was reported as the percent correctly planted, the percent of multiples and the percent of misses.

With the initial design less than half of the plants were properly planted. After design improvements 69 to 72% were planted properly at 15 plants per minute. This dropped to 56 to 64% for a planting speed of 43 plants per minute. Multiple drops, when the machine planted more than one plant per space, were in the 10 to 20% range for the improved machine. About 20% of the spaces were missed altogether.

All three of these transplanters have potential, and, in fact, the intermittent hand unit is field functional except for needing to be mounted on a larger tractor. The ultimate success of these transplanters will depend not only on hardware design but also on the availability of uniform plants predictably arranged so they can be machine located. In addition to improving these transplanters the project is addressing the problems of plant production for automatic transplanting as discussed elsewhere in this report. In addition, a greenhouse has been purchased and will be used to extend the scope

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of our plant production research.

Table 1. Operating characteristics of automatic feeding transplanter. Machine had pairs of hands which gripped the plant, tore it from the strand and placed it into the furrow.

Description	% Misses	% Doubles	% Poorly Aligned	% Improper Depth	Spacing	
					Mean Inches	Standard Deviation Inches
Slow Speed						
Approx. 40 plants/min	0	0	3.3	53.3	22.86	1.00
Approx. 40 plants/min	0	0	3.3	0	21.96	.76
Approx. 40 plants/min	0	0	10	33.3	20.10	2.12
Approx. 40 plants/min	0	0	6.7	20	20.20	1.99
43 plants/min	0	0	4.7	7	21.37	1.89
47 plants/min	0	0	0	0	20.83	1.02
Medium Speed						
59 plants/min	0	0	0	6.8	23.46	.66
78 plants/min	0	10	2.5	5	22.45	.96
78 plants/min	2.5	10	2.5	5	21.53	1.38
Fast Speed						
86 plants/min	0	2.3	0	0	21.13	1.44
100 plants/min	6	2	0	0	22.57	.90

Table 2. Operational characteristics of project designed automatic feeding bare root transplanter.

Speed Plants /Min	Plant Spacing in Tape	% Correctly Planted		% Multiple Drops		% Misses	
		Initial Design	Improved Machine	Initial Design	Improved Machine	Initial Design	Improved Machine
15							
	Uniform	40	69	22	10	38	21
	Variable	39	72	17	10	44	18
43							
	Uniform	40	64	27	15	33	21
	Variable	40	56	22	22	38	22

II. Graduate St

Donald Eddi

IV. Publications

Suggs, C.W.
Part 15

Suggs, C.W.
sawdust

VI. Manuscripts

Suggs, C.W.
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VI. Papers Present

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II. Graduate Students:

Donald Eddington, working toward Ph.D. in transplanting area.

IV. Publications:

Suggs, C.W. 1985. Mechanical harvesting of flue-cured tobacco. Part 15. Last over tractor mounted harvester. Tob. Sci. 29:20-24.

Suggs, C.W. and Alicia Lanier. 1985. Air flow through woodchips and sawdust. Trans. of ASAE 28(1):293-295 & 301.

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Suggs, C.W. Burley mechanization Part 1. Effects of various amounts of priming on yield, price, value and leaf chemistry. Tob. Sci.

Suggs, C.W. and H.B. Peel, Jr. Speed control for hydraulically powered outboard wheel. Trans. of ASAE.

Suggs, C.W. Bright leaf tobacco harvest schedule. Effects on yield and value.

VI. Papers Presented at Professional Meetings:

Suggs, C.W. and H.B. Peel, Jr. 1985. Speed control for hydraulically powered outboard wheel. ASAE Paper # 85-1585.

Suggs, C.W. Bulk curing techniques for leaf quality and fuel efficiency. Third ULTOCO Agronomists Meeting, Torgiano, Italy. August 19-23, 1985.

IX. Acknowledgements:

Research conducted during the reporting period of the mechanization project was supported by a grant from Philip Morris Tobacco Company and the N.C. Tobacco Foundation. Technical assistance was provided by Hilton Peel, James Gore, Linda Blalock, David Williams, Timothy Seaboch, Don Eddington, Stan Leary and Sidney Bland.

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VII. Visiting Professionals:

1. Mr. Sun Ting Cong, Visiting Scholar. Jilin University Chungchun, Peoples Republic of China (8 months): Design and development of intelligent machines.
2. Dr. Marvin R. Paulsen, Visiting Associate Professor. Department of Agricultural Engineering, University of Illinois, Urbana-Champaign (6 months): Computer Vision and Near Infrared Analysis.

VIII. Acknowledgements:

Research conducted during this period was supported, in part, by the N.C. Tobacco Foundation, Inc.

Appreciation is expressed for the continued support and encouragement of Dr. R.E. Williamson, USDA/ARS; Dr. W.W. Weeks, Crop Science Dept., and Dr. F.G. Giesbrecht, Statistics.

Special appreciation is given to Mike McLester for his technical support and encouragement over the years.

Figure

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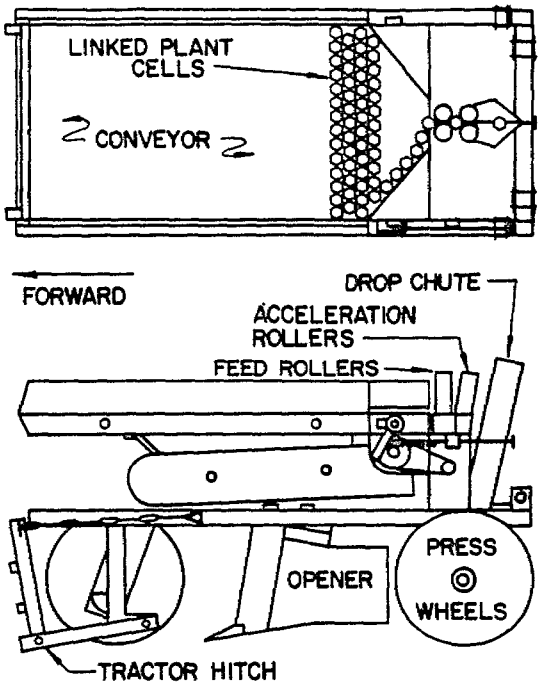

Figure 2. Self feeding transplanter which uses plants grown in a honeycomb of cells which unfolds into a strand or belt of cell carrying plants.

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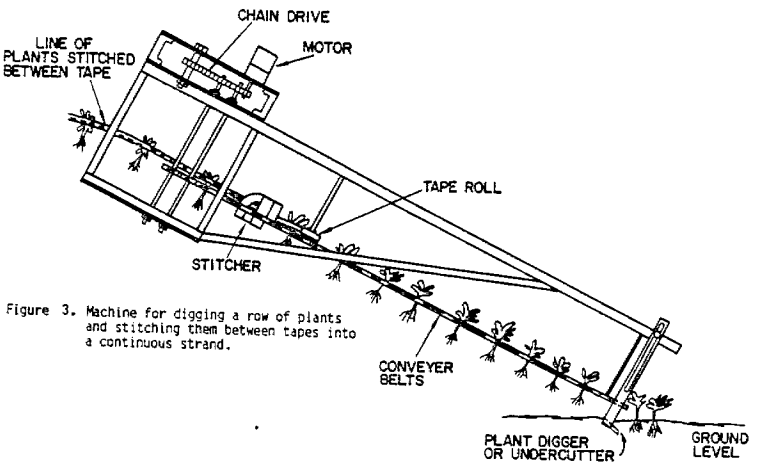
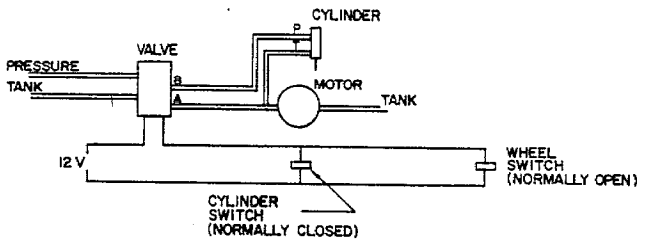


Figure 3. Machine for digging a row of plants and stitching them between tapes into a continuous strand.



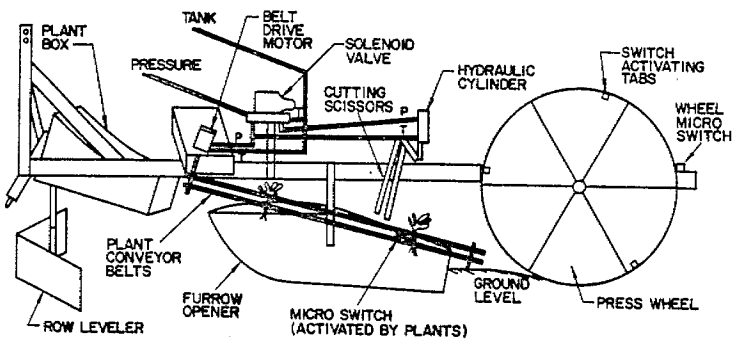


Figure 4. Self feeding transplanter. Stitched plants passing between belts are separated from strand and planted.

Title: NC02136:

Project Leaders:

I. Summary of R

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Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

Title: NC02136: Optimization of Tobacco Curing Systems

Project Leaders: C.F. Abrams, Jr., C.W. Suggs, S.C. Mohapatra and R.W. Watkins

I. Summary of Research:

A. Microwave Heating in Leaf Drying and Sample Preservation

Research was initiated to explore the applicability of microwave energy as an aid to tobacco leaf drying. This undertaking has two objectives: a) determination of the feasibility of microwave radiation as a pretreatment in the curing process; b) use of microwave radiation to provide heat for direct moisture removal for leaf drying and for sample preservation for subsequent chemical analysis. Preliminary results indicate that microwave heating, when properly controlled with respect to intensity and duration, holds promise for both of the above applications with respect to color and final dry weight in that the color at the time of heating can be preserved. Small (7.5 cm dia.) yellowed leaf disks required 30-40 s of high intensity microwave radiation in a conventional home oven to dry without browning. The dry weight is about the same as obtained with freeze drying. Chemical analysis of the samples are in progress to evaluate if microwave heating introduces any undesirable chemical changes, especially with respect to those chemicals which are used as quality parameters of tobacco.

B. Construction of Portable Bulk Curing Chambers

A set of six bulk curing chambers was designed, constructed and operated for six cures at the Oxford Station. They were then moved to the Waynesville Station for burley bulk curing observations. The six chambers are connected side to side into a single unit about 14' long, 8' high and 6' wide, Figure 1. Each unit will hold a maximum of 4 racks but is also designed to hold containers of whole leaf, fragmented leaf or whole plants. Electric resistance furnaces provide the heat and fans circulate the air through the crop. Humidity is controlled manually by selecting the proper damper opening. The barns are essentially air tight so that it is possible to maintain a very high humidity whenever it is desired. Watt-hour meters provide a measure of the heating energy used, two manometers per barn give the pressure readings across the crop and across orifices in the return air space which give an estimate of the air flow. Each barn is operationally completely independent of the others.

The barns were operated successfully but need automatic humidity controllers. They will be brought back to Oxford for the 1986 flue-cured season and then carried to Waynesville for the curing season there.

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C. Bulk Curing of Tobacco Leaf Particles

Chopping or shredding tobacco leaves before curing is attractive because the material is easier to handle, packs more uniformly into the curing chambers and dries more rapidly. The process has been investigated previously (by W.H. Johnson, among others) with mixed results. One of the more serious problems encountered was the early drying of the cut edges before they could proceed from the green to the yellow color.

The curing chambers described in the previous section were used in this study. Because they were so well constructed, especially with respect to air leakage, it was possible to maintain the desired high humidities to reduce the early over-drying of the cut edges. Cut material was loaded into wire boxes which were then placed in the curing chambers.

Each barn held two containers, therefore, it was possible to have 12 treatments per cure. Table 1 shows the treatment combinations which were repeated for each priming. Many of the variables were evaluated at only one level or condition because the number of barns limited additional observations. The work will be continued so that other treatments can be evaluated.

Leaf material was cut into maximum nominal sizes of about 3" x 5" but many particles from the edges of the leaf were much smaller. The cutting equipment consisted of an inclined conveyor fitted with opposing disk shears placed 3" apart which cut the leaves into strips. Strips were cross cut into final size by a two blade rotating shear operating against a ledger plate across the end of the conveyor. Air flow characteristics through this material are reported in the next section of this report. Particles of predominately stem material were generated by cutting off about one-third of the butt end of the leaf. This material was then run through the cutter before it was placed in the curing containers. Particles of predominately leaf material were similarly generated from the tip two-thirds of the leaf. Whole-leaf particles are referred to in the table as "mixed" and "crushed stem" material was material that was passed between a pair of rollers set close enough (about 3/16" - 1/8") to crush the midrib but not bruise the lamina.

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Table 1. Curing Variables and Treatment Combinations.

Treatment	Curing Chamber*	Particle Size	Description	Density lb/box	Cutting Time	Crushing Time	Air Flow
1	1	3"x5"	Mixed	120	Fresh	Fresh	Med
2		3"x5"	Leaf	120	Fresh	Fresh	Med
3	2	3"x5"	Stem	120	Fresh	Fresh	Med
4		3"x5"	Crushed -Mixed	120	Fresh	Fresh	Med
5	3	3"x5"	Mixed	80	Fresh	Fresh	Med
6		3"x5"	Leaf	80	Fresh	Fresh	Med
7	4	3"x5"	Stem	80	Fresh	Fresh	Med
8		3"x5"	Crushed -Mixed	80	Fresh	Fresh	Med
9	5	3"x5"	Mixed	160	Fresh	Fresh	Med
10		3"x5"	Leaf	160	Fresh	Fresh	Med
11	6	3"x5"	Stem	160	Fresh	Fresh	Med
12		3"x5"	Crushed -Mixed	160	Fresh	Fresh	Med

*Assignment of chambers to treatments was changed for each cure.

Particle Curing Results

Although there was some initial difficulty due to inexperience with the new curing barns, good cures were achieved for the third through sixth primings. Although probably not statistically significant, there was a slight decrease in cured weight as a percentage of fresh weight for the more densely loaded barn, Table 3. There was an increase in dry matter loss for the more heavily loaded barn in two cases. In the other two cases the greatest dry matter loss was for the medium loading density.

The last four primings cured well, with average prices falling between $3.85 and $4.21 per kg. The pattern of response is mixed with the intermediate loading density having the lowest price followed, in order, by the high density and the low density. Sugar and total alkaloids generally increased with decreasing loading density.

Heat energy per pound of weight (water) removed from the fresh leaf ranged from 1344 to 2405 Btu. This result indicates that the barns were efficient in that the theoretical requirement is approximately 1000 Btu/lb of water loss. As fresh tobacco is about 6 or 7 parts of water to one part of dry matter, the energy requirements were about 11000 Btu/cured pound.

Heat generated by respiration of the leaf can be estimated by the amount of material consumed during the curing process, that is, the dry matter loss. Comparison of the ratio of this heat output to the furnace heat reveals that

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metabolic heat ranges from about 8 to 15% of furnace heat. This output may be more important than previously thought.

D. Air Flow Through Fresh Tobacco Leaf Particles

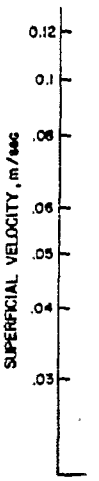
Pressure-flow characteristics of fresh tobacco leaf particles with an area distribution centered at approximately 90 to 120 cm^2 and a weight distribution centered at 7 to 12 grams were evaluated at bulk densities of 198 to 316 kg/m^3. Measurements were made in a 0.61 m by 0.61 m vertical column consisting of three 0.41 m high sections with an upper plenum fitted with a 77.8 mm diameter orifice and a lower, air-input plenum fitted with a 75-watt fan.

Particles from the stem end of the leaf had the least flow resistance followed in order by whole-leaf particles and leaf-tip particles. Figure 2 gives the flow characteristic of lower stalk whole-leaf particles. Flow resistance of intact, aligned, whole leaves was less than for leaf-tip or whole-leaf particles but greater than for stem-end particles. The resistance characteristic was found to be given by $\log Q = \log b + m \log P$ where Q is the flow rate in m^3/s per m^2 of column cross section, and P is the pressure gradient in Pa/m. The slope of the line, m, varied from 0.60 to 0.74 and the unity intercept, log b, ranged from 0.01 for low bulk densities of stem-end particles to 0.001 for high bulk densities of leaf-tip particles.

Decreasing density to 198 kg/m^3 from 277 kg/m^3 (28%) decreased flow resistance and increased flow by approximately 140% for the same pressure. Air flow resistance perpendicular to the particles was significantly greater than for the parallel flow discussed above. For a given pressure and density, perpendicular flow through whole-leaf particles was only about 16% as great as for parallel flow.

Table 2. Curing Characteristics of Leaf Particles from Primings Three Through Six.

Description	Density in Barn	Fresh Weight, kg	Cured Wt kg	% Cured Weight	Dry Matter Loss %	Price $/kg	% Sugar	% T. Alk.
Mixed	High	72	10.4	14.4	16.8	3.84	9.7	2.48
	Med	54	7.9	14.6	21.0	4.06	13.1	2.56
	Low	36	5.4	15.0	13.5	4.03	12.0	2.79
Leaf Tip	High	72	13.0	18.1	13.8	4.07	11.9	2.78
	Med	54	9.2	17.0	16.8	3.94	10.7	2.83
	Low	36	6.4	17.8	14.2	4.21	13.7	2.91
Stem	High	72	8.6	11.9	16.8	4.06	10.2	1.94
	Med	54	6.7	12.4	14.5	3.85	10.2	1.92
	Low	36	4.4	12.2	13.0	3.98	10.8	1.89
Crushed Mixed	High	72	10.4	14.4	17.8	3.91	8.6	2.41
	Med	54	8.3	15.4	17.3	3.92	10.6	2.42
	Low	36	5.5	15.3	16.2	3.91	12.2	2.52



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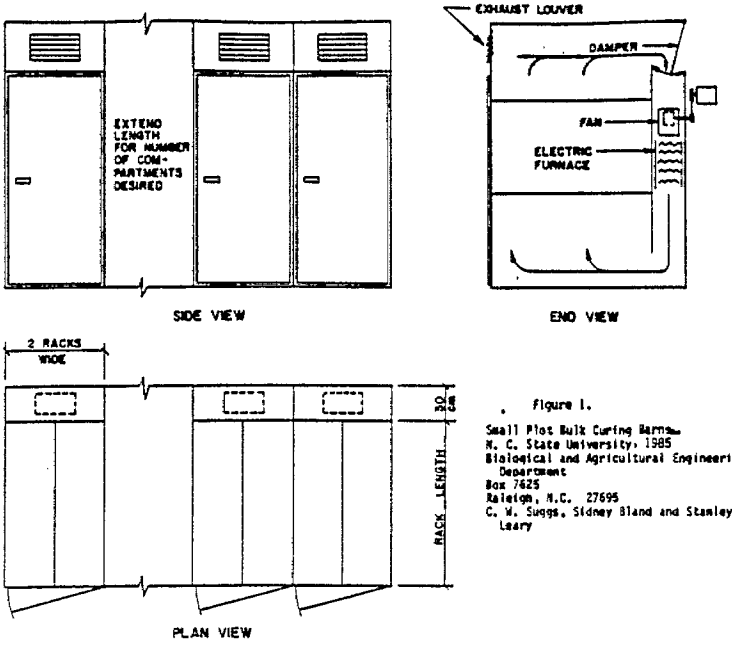

Figure 1.

Small Plot Bulk Curing Barns
N. C. State University, 1985
Biological and Agricultural Engineering Department
Box 7625
Raleigh, N.C. 27695
C. W. Suggs, Sidney Bland and Stanley Leary

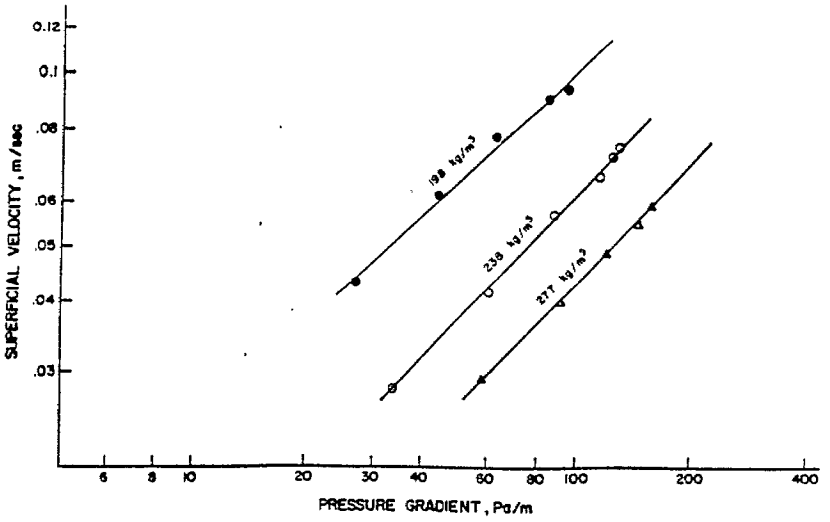

Fig. 2. Air flow versus pressure gradient for three densities of lower stalk whole leaf particles.

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Source: https://www.industrydocuments.ucsf.edu/docs/fjyd0000

Table 3. Curing Barn Performance for Particle Curing from Primings Three Through Six.

Priming	Btu/lb Cured Tobacco	Btu/lb Weight Loss	Metabolic Heat Btu/Barn	Metabolic Heat / Furnace Heat
1	12931	2152	32446	0.087
2	18281	2405	27240	0.056
3	9074	1483	39589	0.128
4	9979	1717	42252	0.121
5	8158	1344	42736	0.156
6	8558	1454	47700	0.157
Mean	11163	1759	38660	0.118

E. Bulk Curing of Burley

The portable bulk curing barns were taken to Waynesville at the end of the flue-curing season at Oxford. Two cures each of about two weeks duration were made. The following treatments were included in each cure:

(1) stalk cut
(2) primed whole stalk medium load density
(3) primed bottom 1/2 stalk medium load density
(4) primed top 1/2 stalk medium load density
(5) primed (a) one rack, top 1/2 stalk high load density
(b) one rack, bottom 1/2 stalk high load density
(6) cut particles (a) whole plant,
(b) top 1/2 of plant,
(c) bottom 1/2 of plant.

Barns were held at a temperature of about 90°F and a humidity equivalent to a wet bulb about 2° below the dry bulb. Under these conditions the leaf turns yellow and then brown. After the brown color developed the temperature was increased and the ventilators were opened to discharge the moist air and dry the tobacco.

Preliminary measurements suggest that bulk cured burley may have slightly different physical characteristics from the conventional air cured material. Some of the primed treatments in the second cure were comparable to air cured material but most of the treatments did not cure well. This is due, at least partially, to the operator's inexperience with the bulk curing equipment and process. Evidence from Clayton and Oxford over several years indicates that primed or stalk cut burley can be successfully bulk cured.

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E. Quantitative Evaluation of Tobacco Quality

Studies in the previous year involved to the development of methodology for certain instrumental means of quality evaluation. This research was undertaken under the categories of Mechanical Properties, Structural and Ultrastructural Properties, Biophysical Properties, Biochemical Properties, and Physiological Properties.

1. Mechanical Properties of Cured Tobacco Leaf as Related to Body and Texture

Methods of mechanical testing and analysis are being applied to determine the feasibility of distinguishing between differing "bodies" and "textures" of flue-cured tobacco leaf by means of directly and objectively measurable mechanical properties. The properties which have been investigated are ultimate strength, viscoelasticity, and static frictional characteristics. Work thus far indicates that repeatable measurements of ultimate strength can be straightforwardly obtained under conditions of controlled leaf moisture, and that ultimate strength of leaf material increases with leaf moisture content. The repeatability of measurement of elasticity was not as good, and there was evident a very definite effect of leaf moisture; elasticity decreased with leaf moisture. Static friction coefficient against the surface of a cold-rolled mill-run aluminum plate increased with moisture content, and some grade separation trends were seen.

Leaf moisture has a very pronounced effect on all mechanical properties measured. Ultimate strength of lamina stips was found to range from 16.5 KPa at leaf moisture of 11.7 % (dry basis) to 28.7 KPa and 37 % moisture content. With leaf moisture maintained constant, however, the measured ultimate strengths were repeatable. Elasticity was also dependent on moisture content, but the elasticity was inversely proportional to moisture content. These results are not unexpected. Increasing moisture renders the leaf material more compliant and soft; thus it can absorb more energy without rupture by allowing more deformation.

Dynamic driving point mechanical impedance measurements showed a typical second order response which may be straightforwardly modelled in terms of linear viscoelastic elements. Again, however, moisture content had a significant effect. The sharpness of the resonance increased as moisture content decreases, but the frequency at which resonance appeared did not change. This result indicates that, at least dynamically, the main effect of moisture content is in viscous damping characteristic of the leaf and that dynamic stiffness may be measurable independently of moisture content. These conclusions are at best tentative, and adequate correlation of these results with subjective grade assessments has not yet been made.

Static friction coefficients were also found to be markedly affected by leaf moisture content as can be seen in Figure 3. There is an indication that the moisture sensitivity differs with grade, with the closed and firm leaf structure grades (C4KM and B4V) showing more moisture dependency than the open leaf structure grade (X4F) tested. It is also interesting that the open leaf structure exhibits higher frictional resistance at moisture contents below about 20 %, while at higher moisture contents the closed and firm structures

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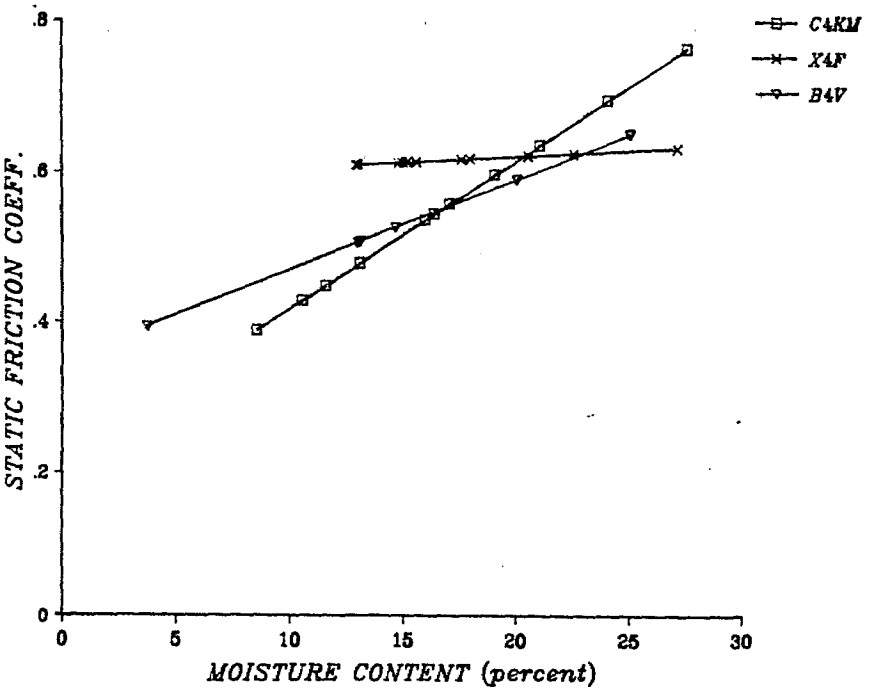

Figure 3. Static friction coefficient flue-cured tobacco samples from closed leaf structure (C4KM), firm leaf structure (B4V), and open leaf structure (X4F) market graded material.

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Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

show higher frictional resistance. This result seems to indicate that the open leaf structure itself allows more "gripping" by the leaf of the mating surface when the leaf is dry; increasing the moisture content may soften this structure and reduce this gripping action while moisture-related adhesion tends to increase that action; the result is a relatively constant apparent frictional resistance as moisture content changes. The closed and firm leaf structures, on the other hand, likely do not change significantly with moisture content within a limited range while the moisture-related surface adhesion results in the increasing apparent frictional resistance with moisture content. The grade indication of the B4V grade of an "oily" texture could also indicate a condition which would cause a moderation of the moisture-related adhesion response and explain the lower rate of increase in apparent frictional resistance with moisture of that grade as compared with the C4KM.

2. Structural and Ultrastructural Properties.

Four tobacco types representing two acceptable and two unacceptable grades were obtained from the R. J. Reynolds Tobacco Company. Anatomical investigations showed distinct structural differences between each tobacco type. However, because of the small quantities of available sample, consistency of their occurrence could not be ascertained. These aspects will be investigated further with samples procured in 1986.

3. Biophysical Properties

The same tobacco samples subjected to structural study were used to measure differences in density, thickness, optical absorption, fluorescence, and other nondestructive methods of analysis. Although research attack for quantitative evaluation of tobacco quality will include various disciplines of chemical, physical, biological and engineering sciences, an eventual development of a method having practical application must be nondestructive and will heavily rely on the biophysical properties of the tobacco leaf. Therefore, this aspect will receive greater attention in the future efforts.

4. Biochemical Properties

The concept of molecular packaging, on which quantitative evaluation of tobacco quality is based, assumes that tobaccos having different qualities will have different chemical constituents packed inside individual cells. While ultrastructural study will reveal the nature of the cells, biochemical investigation will reveal chemical differences. Thus the four tobacco types obtained from the RJR Tobacco Co. were subjected to analysis of oxidative enzymes, optical absorbence and conductivity of the leaf leachates, and chemical composition of ethanolic extract of the leaf. Quantitative differences were observed among the four tobacco types with respect to each constituent studied.

5. Physiological Properties

While analytical methods must be developed to quantitatively evaluate tobacco quality, the greater challenge lies in the ability to produce tobaccos of desired quality. To accomplish this the physiological interaction of the tobacco leaf with the curing conditions must not only be understood as an after-the-fact situation, but must also be predictably manipulated to give desired results. So far, most curing research regarding stalk position has

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been based on priming, without regard to the fact that each priming consists of several different leaf positions. Research under this heading was conducted with respect to each individual leaf. Progressive changes in moisture, dry weight, and chemical constituents are being analyzed. Further, gas-chromatographic analyses are in progress to monitor progressive development of aroma during curing.

It has been recognized from the beginning that knowledge on the developmental physiology of the tobacco leaf will play a major role in enhancing our basic understanding of the quantitative aspects of the tobacco quality. These objectives are being served through ongoing enzymatic and chemical investigations relative to tobacco leaf development.

II. Graduate Student:

S. Sahi - Development Physiology of the Tobacco Leaf

III. Postdoctoral Fellow:

Dr. B. Mohanty - Ultrastructural and Chemical Characterization of Tobacco Quality.

IV. Publications:

Suggs, C.W., A.L. Zimmer and J.W. Gore. 1985. Pressure versus air flow through fresh tobacco leaves. Transactions of the ASAE. 28(5):1664-1667.

VI. Manuscripts in Review:

Suggs, C. W., P. E. Harris and H. B. Peel, Jr. Development of a wireless controller for an electric hoist. Transactions of the ASAE.

Suggs, C. W., L. L. Blalock and H. B. Peel, Jr. Air flow through fresh tobacco leaf particles. Transactions of the ASAE.

VII. Papers Presented at Professional Meetings:

Suggs, C. W. Effects of leaf configuration and bulk density on curing and fuel consumption. ASAE Paper # 85-3055.

Mohanty, B., and S. C. Mohapatra. Relationship between superoxide dismutase and leaf position in tobacco. Annual Meeting, Amer. Soc. Plant Physiol., Providence, RI, June 8-13, 1985.

VIII. Graduate Student Theses Completed During Reporting Period: None

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IX. Acknow

The t
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The technical assistance of Hilton Peel, Sidney Bland, Stanley Leary, Valsa Samuels, Sudha Ramesh, Tim Foutz, James Gore, Prem Singh, David Williams, Linda Blalock, Tina Brunner, Bradley Bennett, and the staff of the Biological and Agricultural Engineering Research and Electronics Shops was essential to the execution of this research. Secretarial assistance was provided by Brenda Mason and Ann Griffin.

Research on quantitative evaluation of tobacco quality was supported by R. J. Reynolds Tobacco Company, Winston-Salem, NC.

2000270188

Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

Title: NC 02136, Optimization of Tobacco Curing Systems

Project Leaders: Rupert Watkins and C. W. Suggs

I. Summary of Research:

Flue-cured tobacco quality is profoundly influenced by curing schedule. One curing factor of prime importance is temperature elevation rate. It is generally accepted that slower elevation rates are more conducive to optimum leaf quality. Faster rates are thought to be more energy efficient and to require less curing time. NCSU's curing recommendations show a 2° per hour elevation rate which may be a compromise.

The objective of this research was to evaluate the effect of temperature elevation rate on final leaf quality. Three rates were chosen for testing: 1°F per hour, 2°F per hour, and 3°F per hour. Final leaf quality was measured by market price.

Six small portable curing barns were fabricated for this test. These barns were built as nearly identical as practical, were tight, well insulated and equipped for automatic temperature and humidity control. These barns were three tiers tall, held 18 standard bulk racks, and were equipped with fans sized to give air flow rates about equal to those of standard bulk barns. The barns were heated by water-to-air heat exchangers which received hot water from one central source.

These curing tests were conducted on a farm in Johnston County where the tobacco operation could be adjudged no less than excellent. Popular commercial varieties were grown and all NCSU recommendations were met or exceeded. For each test all barns were loaded the same day with similar tobacco. This was no problem since this farmer had 40 acres of tobacco in one field. The harvesting method was: hand priming and bulk curing with racks loaded at the barn.

Twenty-seven barn loads were cured with tobacco from three primings (stalk positions). The crop was actually primed four times with the first priming being simply left on the ground in the field. At least two barn loads were cured at each temperature elevation rate with tobacco from each stalk position. Tobacco from each test was sold at the same warehouse at the same time and government grades and sale prices were recorded (see Table I). There were two sheets or "market samples" from each barn load.

No price difference was noted for the three temperature elevation rates with lower and middle stalk tobacco. For the upper stalk tobacco (about 8 leaves per plant) the 3°F per hour rate showed a slightly depressed price.

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Table I. Mark

Stalk Position

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Middle
Upper
Upper
Upper
Upper

Average Price

*Numbers in p units".

Governme temperature e Grades were s the 3°F per h

Table II. Gc

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IV. Publica

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Table I. Market Price (in $ per lb) Received For Tobacco Cured Using Different Temperature Elevation Rates

Stalk Position	1°F/Hr. Weight	1°F/Hr. Price	2°F/Hr. Weight	2°F/Hr. Price	3°F/Hr. Weight	3°F/Hr. Price
Lower	(4)* 658	1.71	(4) 647	1.71	(4) 654	1.71
Middle	(4) 702	1.83	(4) 726	1.83	(4) 758	1.83
Upper	(6) 1143	1.82	(6)1134	1.82	(6)1093	1.82
Upper	(4) 839	1.89	(4) 806	1.89	(2) 390	1.82
Upper					(1) 190	1.86
Upper					(1) 176	1.89
Average Price		1.80		1.80		1.79

*Numbers in parenthesis indicate number of sheets of tobacco or "market sale units".

Government grades for all tests are shown in Table II. Grades for all temperature elevation rates were identical for the lower and middle stalk leaf. Grades were slightly different for two tests of upper stalk leaf cured with the 3°F per hour rate.

Table II. Government Grades For Leaf Cured Using Different Temperature Elevation Rates

Test No.	1°F/Hr. No. Sheets	1°F/Hr. Grade	2°F/Hr. No. Sheets	2°F/Hr. Grade	3°F/Hr. No. Sheets	3°F/Hr. Grade
1	2	X3KM	2	X3KM	2	X3KM
2	2	X3KM	2	X3KM	2	X3KM
3	2	C4KM	2	C4KM	2	C4KM
4	2	C4KM	2	C4KM	2	C4KM
5	2	B4KM	2	B4KM	2	B4KM
6	2	B4KM	2	B4KM	2	B4KM
7	2	B4KM	2	B4KM	2	B4KM
8	2	B4K	2	B4K	1	B5K
8					1	B4KM
9	2	B4K	2	B4K	1	B4K
9					1	B4KM

IV. Publications:

Mechanization, Rupert W. Watkins, Tobacco Information 1986, N.C. Agri-Extension Publication AG-187, pp. 109-118, Nov. 1985.

2000270190

Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

Title: NC 02124 Instrumentation and Procedures to Measure Quality and Composition of Agricultural Products

Project Leader: W.F. McClure

I. Summary of Research:

Objective evaluation of traditional criteria of tobacco quality, particularly those criteria involving considerable subjectivity, will no doubt require the development of a correlation model involving more than one objective measurement. The characteristics of color, body and texture will not be fully defined by any one single objective measurement.

Optical measurements offer several advantages in studying tobacco quality: (1) the measurements are quick, providing rapid feedback of the desired parameters; (2) optical measurements are nondestructive which permits the measurement of more than one optical parameter on the same sample, and (3) the measurements are known to be associated with both chemical and physical properties, both properties being involved in traditional evaluations.

The objective during this reporting period was to determine the feasibility of near infrared technology to measure color and body of tobacco. To do this, 196 samples of tobacco were selected from 4 stalk positions (lower(L), mid-plant (MP), upper middle (UP), above middle (AM)) and four sales regions (Georgia, South Carolina, Eastern North Carolina and Old Belt). Government grades for each stalk position was P5L(L), B3F(MP), B3XM(UP), and B4K(AM). The intent was to produce the stalk position "body phenomenon" with as varied material as possible. An additional 160 samples were selected for the color studies.

Results and Discussion

Color. Tobacco color may be evaluated by two methods: (1) Tri-stimulus Colorimetry or (2) Directly from the reflectance spectrum of the tobacco. The latter approach was chosen over the former because reflectance instrumentation is less cumbersome and can provide spectral resolution far superior to that of Tri-stimulus Colorimetry (tri-stimulus colorimetry uses three very broad-band filters in the visible region from 400-750 nm). Furthermore, high resolution spectra are needed when information is required for chemical measurements.

Near infrared spectra exhibit color transitions in the region 900 to 1460 nm. Beyond that region, the effects of color are not detectable. That this is true can be observed in Figure 1. Note that this dark sample tends toward higher log(1/R) values in the "color region" specified above; the bright tobacco has lower log(1/R) values in this region.

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A total of 160 samples were selected and sorted into two classes of color and assigned the indicies 5-bright and 1-dark. The files were split into two files, the odd numbered spectra in one file and the even numbered spectra in another file.

An stepwise multiregression was run on the odd samples to yield a calibration equation for the NIR spectrophotometer. The equation took the form

$$\text{Color} = 5.00 - 28.78L_{910} - 25.90L_{1690} + 37.14L_{1926} + 37.07L_{2238} - 46.22L_{2304} - 32.29L_{2016} + 35.54L_{1146} + 16.28L_{2534} \quad \ldots\ldots\ldots\ldots\ldots\ldots [1]$$

The file containing the even numbered samples was used to test the calibration. Note that the first four terms in Equation [1] are measures of slope in the color region talked about above. A plot of the calibration and prediction results are shown in Figure 2.

Body. Body, as defined by stalk position, can be measured with a high degree of accuracy as shown in Figure 3. Figure 3A is a calibration based on the 98 odd-numbered samples from the 196 which were scanned. Figure 3B shows estimates of the 98 even-numbered samples.

The calibration equation from Figure 2A was of the form

$$SP = 2.063 + 527.24\ L_{2251} - 128.60\ L_{1623} - 421.56\ L_{2279} - 54.00\ L_{2031} + 16.38\ L_{977} + 60.40\ L_{1485} \cdots\cdots [2]$$

There are a couple of observations pertinent at this point. The first wavelength selected by the computer for the calibration regression was 2251 nm, a wavelength known from other studies to correlate with nicotine and which corresponds closely to a major absorption band of nicotine. This is further substantiated by noting in Figure 3 that the nicotine levels of the various stalk positions followed the same pattern as that predicted by NIR.

The last two wavelength chosen in the calibration equation were 977 and 1485 nm. Hence, it seems plausible that the calibration process brings into the equation a measure of color, already discussed above.

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As one would suspect, the 95% confidence limits for the estimates in Figure 2B are wider than those for the calibration curve (Figure 2A). Additionally, it can be seen in Figure 3 that a correlation exists between chemistry (nicotine) and stalk position (body), a correlation which dates to the 1800's.

Nitrogen

Cooperative work with USDA (Dr. R.E. Williamson) continued during this reporting period. Analyses of the NIR spectra from 200 flue-cured tobacco samples show that nitrogen levels can be estimated with a standard error of estimate of 0.10% over the range of 1.5 to 2.1% (CV = 4.96%). Results show a preference for the first derivative spectra over log (1/R) or the second derivative spectra.

IIA. Graduate Students:

1. Roger M. Hoy: Robotic Grippers with Tactile Feedback
2. M. Scott Howarth: Computer Vision Systems for Evaluating Quality

IIB. Special Student:

1. Michael A. Taylor, Special Student: Optical Measurements of Subjective Quality Factors

III. Visiting Professionals:

1. Dr. Marvin R. Paulsen, Visiting Associate Professor. Department of Agricultural Engineering, University of Illinois, Urbana - Champaign: Computer Vision and NIR Technology (6 months).

2. Gao Wenyu, Visiting Scholar. Huazhong Agricultural College, Wuhan, Peoples Republic of China (2 years): Intelligent Machines and Near Infrared Technology.

IV. Publications:

1. Firestone, L.M. and W.F. McClure. 1983. VLSI architectures for image processing. In "Agricultural Electronics, 1983 and Beyond" (pp. 621-630). The ASAE, St. Joseph, Michigan, 49085-9659.

2. McClure, W.F. 1984. Status of NIR technology in the tobacco industry. Proceedings of an International Symposium on Near Infrared Spectroscopy 1: 127-133. Melbourne, Australia (October 15-16).

3. McClure, W.F. Fourier analysis of near infrared spectra. Proceedings of an International Spectroscopy 1:43-61. Melbourne, Australia (October 15-16).

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VII. Papers

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4. Davies, A.M.C. and W.F. McClure. 1985. Near infrared analysis in the Fourier domain with special reference to process control. Analytical Proceedings (England 22:321-322.

V. Manuscripts Accepted to Publication:

1. Kano, Y. and W.F. McClure. 1984. A near infrared reflectance soil moisture meter. Transactions of the ASAE, St. Joseph, Michigan.

VI. Manuscripts in Review:

1. McClure, W.F. 1985. Near infrared analysis of forages.

2. McClure, W.F. 1985. Near Infrared Reflectance Spectroscopy: I. Operating in Wavelength Space.

3. McClure, W.F. 1985. Near Infrared Reflectance Spectroscopy: II. Operating in Fourier Space.

4. McClure, W.F. 1985. Derivative enhancements in Fourier space.

5. Seymour, S.K. and W.F. McClure. 1984. Development of a low cost derivative spectrophotometer for analyses of agricultural products.

VII. Papers Presented at Professional Meetings:

1. McClure, W.F. and A.M.C. Davies. 1985. Fourier analysis of near infrared spectra. International Conference on Fourier and Computerized Infrared Spectroscopy, Ottawa, Canada (June).

2. Davies, A.M.C., S.M. Ring, J. Franklin, A. Grant, and W.F. McClure. 1985. Prospects for process control using Fourier transformed near infrared data. International Conference on Fourier and Computerized Infrared Spectroscopy, Ottawa, Canada (June).

VIII. Acknowledgements:

Research conducted during this reporting period was supported in part by the North Carolina Tobacco Foundation, Inc. and by R.J. Reynolds Tobacco Company.

Appreciation is expressed for the continued cooperation of Dr. R.E. Williamson, USDA/ARS; Dr. W.W. Weeks, Crop Science Dept.; and Dr. F.G. Giesbrecht, Statistics.

Special appreciation is given to Mike McLester for his technical support over the years.

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Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

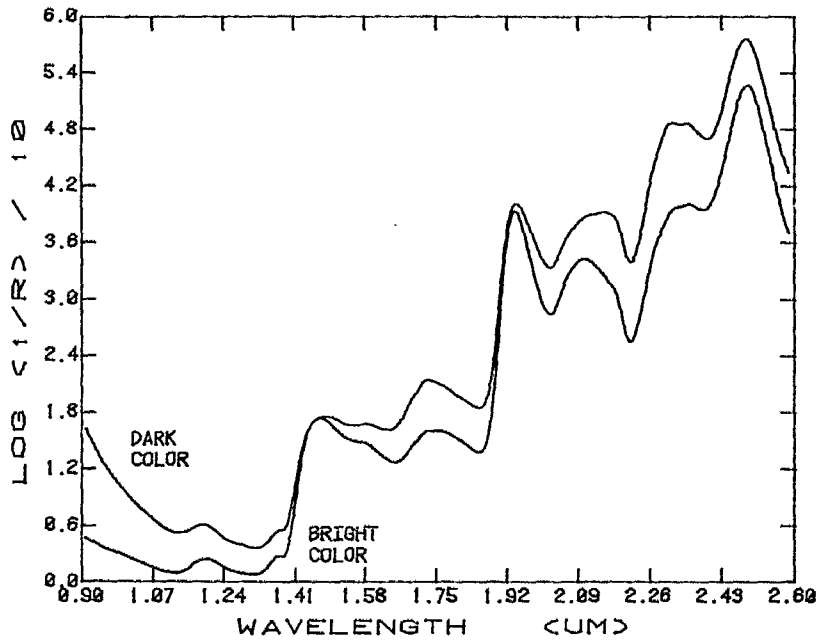

Figure 1. Near infrared spectra of two tobacco samples each differing from the other in color.

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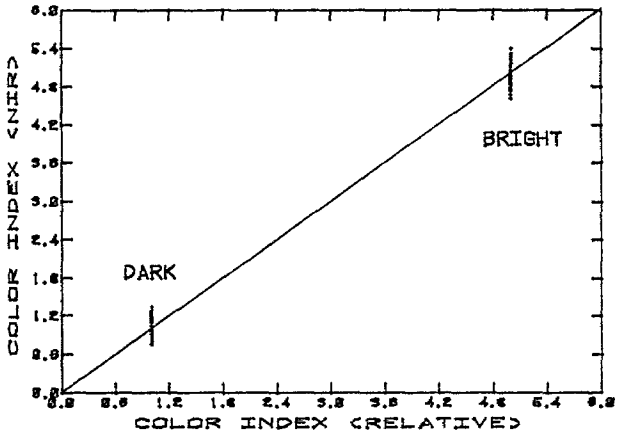

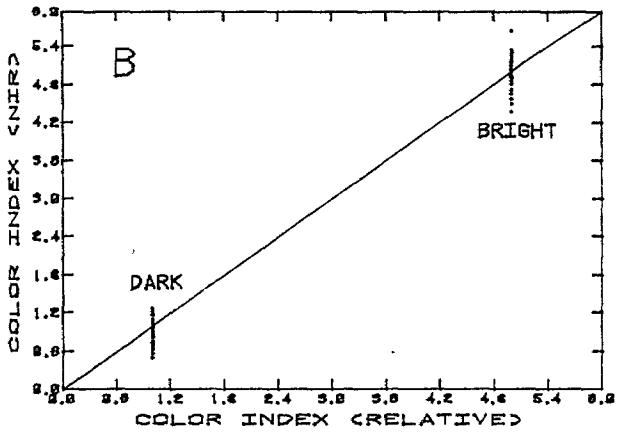

Figure 2. Measuring color by near infrared reflectance, spectroscopy: (A) calibration, (B) prediction.

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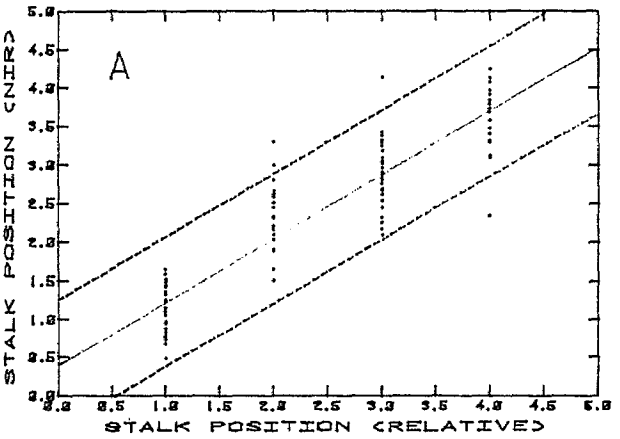
Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000



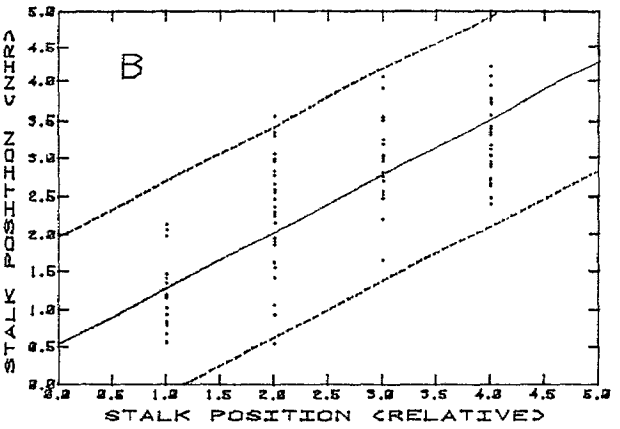


Figure 3. A plot of the calibration (A) and prediction (B) data from the 196 samples scanned with the COMP/SPEC. The dotted lines are the 95% confidence limits for the plots.

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Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

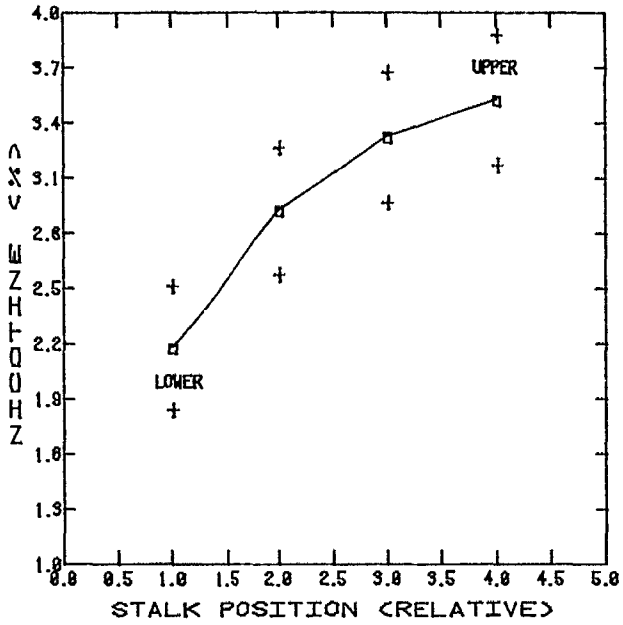

Figure 4. Nicotine levels for each of the four stalk positions. The + marks indicate the standard deviation of the data at each stalk position.

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Title: NC 03919 Characterization of Meristem Morphogenesis: Cytohistological and Anatomical Changes in the Apical Meristem of Tobacco During the Transition to Flowering.

Project Leader: Judith F. Thomas

I. Summary of Research:

A. To describe the anatomical and quantitative cytohistological features of the apical meristem of tobacco plants as growth progresses from the vegetative to reproductive stage of development under various photoperiod and temperature regimes.

B. To compare meristematic development in the day neutral variety of flue-cured tobacco, NC2326, with that of its short-day isogenic counterpart, NCTG-22.

Two types of flue-cured tobacco plants, the day-neutral NC2326 and its short-day isogenic counterpart, NCTG-22, were grown under various day/night temperatures regimes and photoperiods in the Phytotron to either hasten or prolong the vegetative to reproductive transition. Stem apices obtained from these studies were prepared for light and electron microscopy and Feulgen microdensitometry to examine the anatomical and cytohistological changes as development progressed from the vegetative, transition, and reproductive phases. Rates of change in meristematic development and degree of response to prescribed environmental changes were correlated with leaf production in the two types of tobacco. Quantitative estimates of changes in the apex which were obtained were used to discriminate between those changes which were an essential part of the flowering process and which were merely accompaniments of growth of the meristem as it aged. Results from this study contributed to information on flowering physiology and had direct application to commercial tobacco production as well by determining when the apex reached the "point-of-no-return" in its commitment to flowering.

In the final phase of the study, which was conducted during this reporting period, ultrastructural differences in organelle composition in the cells of tunica and corpus layers in the central zone of shoot apices of the short-day tobacco, NCTG-22, were observed during the 17-day transition period from vegetative to reproductive growth. Under short days changes in tunica cells included the reduction in size of cells, nuclei, vacuoles,and proplastids, while mitochondrial size increased. Tunica cells responded to induction after one exposure, while corpus cells required seven or more exposures to the floral photoperiod. The changes in organellar composition of tunica and corpus cells suggest that each layer was independent in readjustment of rate of growth towards the new pattern of development, and that for this species, the epidermal layer (i.e., tunica layer) plays a dominant role in controlling the initial morphogenetic change.

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II. Graduate Students: Malee L. Kanchanapoom, Ph.D.

IV. Publications:

Kanchanapoom, M. L. and J. F. Thomas. 1985. Stereological Study of Ultrastructural Changes in the Shoot Apical Meristem of Tobacco During Floral Induction. Pl. Phys. 77:111.

VI. Manuscripts in Review:

Kanchanapoom, M. L. and J. F. Thomas. Stereological Study of Ultrastructural Changes in the Shoot Apical Meristem of Nicotiana tabacum During Floral Induction. Submitted to American Journal of Botany.

Kanchanapoom, M. L. and J. F. Thomas. Quantitative Ultrastructural Changes in Tunica and Corpus Cells of the Shoot Apex of Nicotiana tabacum During the Transition to Flowering. Submitted to American Journal of Botany.

Kanchanapoom, M. L. and J. F. Thomas. Changes in Nuclear DNA Content in the Apical Meristem of Nicotiana tabacum During Floral Evocation. Submitted to American Journal of Botany.

VII. Papers Presented at Professional Meetings:

Kanchanapoom, M. L. and J. F. Thomas. 1985. Stereological study of ultrastructural changes in the shoot apical meristem of tobacco during floral induction. A paper (poster) presented at the annual meeting of the American Society of Plant Physiologists, Providence, RI, June 27, 1985.

VIII. Graduate Student Thesis Completed During Reporting Period:

Kanchanapoom, Malee L. "Nuclear DNA and Ultrastructural Changes in the Apical Meristem of Tobacco During the Transition from Vegetative to Reproductive Development": a thesis submitted to the Graduate School (January 1986) in partial fulfillment of the requirements for the Ph.D. degree.

2000270200

Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

Title: NC 03905 Limit Growth of Metabolic Sinks to Enhance Quality of Flue-cured Tobacco

Project Leader: H. Seltmann (USDA, ARS)

I. Summary of Research:

A. Preliminary regional tobacco growth regulator test.--The regional committee selected to study SDS-36991, a potential new sucker controlling agent that is a systemic-acting contact agent, in dual applications with the third application being KMH or none and in a single sequential application with KMH. In addition, two newly formulated contact agents, IAP-812 and IAP-1010 (fatty alcohols), and a newly formulated KMH, IAP-680, became available for study. SDS-36991 resulted in satisfactory sucker control only when used in dual applications followed by a full rate of KMH. The dual applications compared favorably only with the dual applications of fatty alcohols. The newly formulated fatty alcohols showed somewhat greater activity than the fatty alcohols control, while the newly formulated KMH did not show any increased activity over the KMH control. (See Table 1.)

B. Advanced regional tobacco growth regulator test.--Prime+ (fluometralin) and Bud Nip (chlorpropham) were recently labelled for tobacco sucker control. These are systemic-acting contact agents. The former was studied in tankmixes with KMH using both at reduced rates and the latter with fatty alcohols. In sequential applications following fatty alcohols Prime+ usually resulted in better sucker control than KMH. In this study it was found that a tankmix of half rates of Prime+ and KMH resulted in control as good as with the Prime+ at full rate (91 mg/plant). When the amount of KMH was reduced to one-third the labelled rate, the control was slightly less than when the half rate was used. The findings indicated a way to reduce MH residues on tobacco and at the same time reduce the amount of Prime+ that could carry over into the cover crop without impairing sucker control.

The tankmix of fatty alcohols with 1% Bud Nip resulted in inadequate sucker control. It is suggested that an increased amount of the Bud Nip in the tankmix be included in any further studies.

It should be noted that the Kinston location suffered from an extremely dry period at a time when the tobacco was in its major growth period prior to topping, at treatment time, and for some time thereafter. No irrigation was available at this location (See Table 2).

C. Directed vs overall spray applications of sucker-controlling agents.-- Knowing that the directed spray technique will reduce residues of any agent applied in this manner because less of the leaf surface is wetted, we continued the comparison study with the overall application using commercial and experimental chemicals in various combinations. We found that MH (170 mg/plant), Prime+ (91 mg/plant), and Bud Nip (170 mg/plant) were highly satisfactory in both methods of application when they

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followed dual applications of fatty alcohols (FA), one in the bud stage and the next in the early flower stage as 4% and 5%, respectively. Two variations with the MH and FA that resulted in excellent control were (1) FA (4%) in the early bud stage followed by two applications of half rates (85 mg/plant) of MH, one at the late bud stage and another in the early flower stage of plant development; (2) a tankmix of FA (4%) with 42 mg/plant of MH in the early bud stage followed by another tankmix of FA (5%) and 43 mg/plant MH in the late bud stage and then followed by 85 mg/plant of MH after topping in the early to full flower stage of plant development. Yields were not different among these treatments.

Two treatments to not topped plants were MH (212 mg/plant) applied in the early bud stage and a tankmix of MH (170 mg/plant) and ethephon (75 mg/plant) applied in the late bud stage following FA in the early bud stage. These plants were topped four weeks after the initial applications. At topping neither treatment had developed seed capsules. The MH-ethephon treatment was of interest because the lower leaves yellowed slightly faster than any of the other treatments and the yield was lower. Total alkaloids were lower in both because of the later topping. Sucker control was not adequate. (See Table 3.)

D. Carry-over studies of Prime$^+$ on small grain cover crops.--We have reported previously that sucker controlling agents that are substituted dinitroanilines will affect the small grain cover crops, especially when weed control in the tobacco crop is practiced with another substituted dinitroaniline. The four treatments in the present study were (1) Paarlan for weed control with MH for sucker control, (2) Prime$^+$ for sucker control but no chemical used for weed control, (3) Paarlan for weed control and Prime$^+$ for sucker control, and (4) no chemical for weed control and MH for sucker control. The cover crop one month after seeding showed a 14% reduction in the number of plants in treatment #1, 18% in #2, and 32% in #3 when compared to the control (#4). Fresh weight per plant was reduced 20% for #1, 27% for #2, and 30% for #3 when compared to the control (#4). Thus, it was found that not only the combination of dinitroaniline suckering and herbicide agents will effect the cover crop, but also that their effects were noted separately. Carry-over effects on corn and/or tobacco will be followed during the 1986 season.

The study is in cooperation with the NCSU Pesticide Laboratory (T. J. Sheets) where tissue and soil residues are being determined.

E. Yellowing tobacco with 2,4-D and dicamba.--Treated plants yielded more and had better quality as determined by dollars per hundredweight, quality index, and visual warehouse appraisal when compared to the not treated plants. These results are just the opposite of those obtained in 1984. Samples are presently being analyzed by the N. C. Department of Agriculture laboratory for chemical residues to obtain a base for this illegal use of these pesticides.

F. Evaluation of plant growth regulators not previously reported on tobacco.--DCPTA (2-diethylaminoethyl-3,4-dichlorophenylether) that reportedly increased lipid content by 20% and yield by 35% in soybeans was found to have no effect on greenhouse or field grown tobacco. AC-239,604 and AC-239,904 when used as sucker controlling agents alone or in tank-mixes with fatty alcohols or MH had no controlling effect.

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Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

II. Graduate Students:

Rawls, Eric K. "The effect of fluometralin as a sucker control agent on flue-cured tobacco." M.S. Crop Science, NCSU

IV. Publications:

Sheets, T. J., and H. Seltmann. 1985. "Residue and sucker control from two formulations of maleic hydrazide (MH)." Beitr. Tabakforsch. 13:55-58.

VII. Graduate Student Theses Completed During Reporting Period:

Wheeler, Jeffrey, J. 1985. "The mode of action of fatty alcohols in tobacco culture." M.S., Botany, NCSU.

Meyer, Susan A. 1985. "Effect of application time on free and bound MH in flue-cured tobacco." M.S., Toxicology Program, NCSU. (Co-Chairman with T. J. Sheets)

IX. Acknowledgements:

Joseph A. Priest for excellent technical assistance.

2000270203

Table 1.

Treatments
HS
FA/FA 4%,
FA/KMH 4%,
SDS-36991/S
SDS-36991/K
SDS-36991/S
SDS-36991/S
IAP-812/IAP-
IAP-1010/IAI
FA/IAP-680
IAP-812/IAP-

*Mean of Kin

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Table 1. 1985 Preliminary regional sucker control test.

Treatments	Agronomic characteristics*					
	Sucker control (%)	Yield (lb/a)	Price index ($/cwt)	Acre index ($/a)	Quality index	Degree of injury
HS	51	1926	164	3192	41	-
FA/FA 4%/5%	24	1485	155	2298	44	0
FA/KMH 4%/170 mg	38	2116	166	3536	29	0
SDS-36991/SDS-36991 151 mg/151mg	17	1645	164	2710	51	0
SDS-36991/KMH 151 mg/170 mg	53	1969	173	3430	58	0
SDS-36991/SDS-36991/KMH 151 mg/151 mg/170 mg	97	2385	167	3984	38	0
SDS-36991/SDS-36991/KMH 76 mg/76 mg/170 mg	97	2474	167	4181	38	0
IAP-812/IAP-812 3%/4%	33	1496	161	2371	59	0
IAP-1010/IAP-1010 3%/4%	34	1602	160	2534	43	0
FA/IAP-680 4%/170 mg	46	1877	167	3161	38	0
IAP-812/IAP-680 3%/170 mg	38	1963	167	3353	47	0

*Mean of Kinston and Oxford. 2 reps per location.

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Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

Table 2. 1985 Advanced regional sucker control test.

Treatments	Agronomic characteristics*					
	Sucker control (%)	Yield (lb/a)	Price index ($/cwt)	Acre index ($/a)	Quality index	Degree of injury
HS	46	2140	169	3621	48	-
FA/KMH 4%/170 mg	20	2834	170	3542	48	0
FA/Prime+ 4%/ 91 mg	54	3210	168	4089	46	0
FA/(KMH + Prime+) 4%/(85 mg + 45 mg)	68	3187	169	4188	45	0
FA/(KMH + Prime+) 4%/(57 mg + 45 mg)	59	3028	166	3942	42	0
FA/(FA + Bud Nip) 4%(4% + 1%)	9	2557	163	4377	46	0

*Mean of Kinston and Oxford. 4 reps per location.

Table 3. Directed vs overall spray applications of sucker-controlling agents.

	Treatment	Sucker control %		Yield lb/acre		Total alkaloids %	
		X	0	X	0	X	0
1	Topped, not suckered	-	-	1811	1834	1.72	1.79
2	FA/FA/MH 4%/5%/170 mg	100	100	2755	2731	2.32	2.23
3	FA/FA/Prime+ 91 mg	97	95	2730	2917	2.34	2.30
4	FA/FA/Bud Nip 170 mg	99	98	2787	2734	2.18	2.24
5	MH 1.25x	79	79	2580	2679	1.78	1.97
6	FA/(ethephon + MH)	73	76	2203	2208	2.03	2.05
7	FA/0.5x MH/0.5x MH	99	99	2680	2667	2.27	2.36
8	(FA + 0.25x MH)/ (FA + 0.25x MH)/0.5x MH	100	99	2613	2641	2.27	2.32
9	FA/(FA + AC-239604)	44	43	2686	2675	2.25	2.12
10	FA/FA/SDS-36991	99	98	2722	2739	2.37	2.33

X = directed; 0 = overall

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Title: 03917 - INVESTIGATIONS IN TOBACCO TRANSPLANT PRODUCTION

R. C. Long

Evaluation of Experimental Plant Bed Covers (R. C. Long and T. A. Bartholomew)

Several experimental plant bed covers were evaluated to determine the rate at which tobacco transplants were produced relative to their production under systems using commercial materials.

Two locations, Central Crops Research Station (CCRS) and the Border Belt Tobacco Research Station (BBTRS), were chosen as sites for the evaluation. Standard transplant production methods were employed at each site, the only variable at each site being the cover materials, i.e., treatments. The general protocol was to seed the beds, irrigate lightly, and to then cover them with the covers. The treatments (cover materials) were as follows: 1-plastic; 2-Reemay; 3- Heavy Duty Reemay; 4- DP (DuPont) 9626-91-6C; 5- DP 9626-91-6UC; 6-DP 9626-91-5C; 7- KC (Kimberly Clark; a polypropylene material). Each experimental bed was approximately 6 ft x 6 ft. A randomized block design with four replications was used at both locations. Maximum/minimum thermometers were placed under the bed covers in one replication at both locations following placement of the covers.

CCRS. The treatments were established on February 27, 1985. Unfortunately, germination of the seed lot used (c.v. McNair 944) was extremely poor in this test and in several others at the station and was attributed to poor seed. By the time that it was evident that germination was very poor, it was too late to reseed. Although a few plants were produced in each treatment, they were insufficient to determine growth rates. Although temperature readings, begun on March 6, were continued until April 18 when the test was discontinued, they are not presented in this report because the poor plant stand may have affected temperatures under the covers.

BBTRS. The beds were seeded on February 18, 1985, but were not irrigated and covered until February 25. Temperature readings were begun on February 26 and continued through April 11. The plastic cover in Trt. 1 was replaced with Reemay on April 3 to prevent plant scalding by the hot plastic as air temperature rose.

On April 11, a 1 sq. yd. area in the middle of each bed was marked off and transplant sized plants were pulled. The plants were separated into three categories (small, < 10 cm from root crown to bud; optimum, 10-17 cm; too large, > 17 cm) and the number in each counted. The plants in the optimum category were further separated into "usable" and "spindly," the latter representing plants with small diameter stems which often results in poor establishment and growth in the field.

The same areas were pulled again on days 2, 4, 7, and 10. At the last day, the beds were pulled clean of all plants.

The total number of plants produced by a treatment was calculated by summing the total number of plants obtained at each pulling across the five pullings. In one sense, this variable might be considered as total germination or total plants established.

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Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

Because of the large number of plants obtained in the "too large" category at the first pulling, there was concern that the different treatments might be biased as to their potential for plant production. Consequently, another category was calculated: all plants > 10 cm at a pulling plus plants < 10 cm at the previous pulling = large plants. The rationale used was as follows: Had the small plants not been pulled on the previous pulling, they would have grown to 10 cm or greater by the current pulling. As such, "Large Plants" was a better description of the ability of a particular treatment to produce transplant-sized plants.

The total number of plants produced was subjected to an analysis of variance. The cummulative number of optimum-sized plants, usable plants, and large plants were determined for each pulling date and the data were subjected to analysis by a general linear model. The means were then plotted as a quadratic function of pulling date.

The temperature data were analyzed by a fourth-order regression procedure and the predicted means plotted as a function of time. Although the use of higher order regressions would probably have improved the fit (R^2), the analysis was adequate in showing that the different treatments resulted in different temperatures under the covers.

All treatments produced higher maximum temperatures than the maximum air temperature (Fig. 1). The plastic cover (Trt. 1) resulted in the highest maximum temperature under the covers throughout the study. Treatments 2 and 3 seemed to result in the lowest maximum temperatures during the plant production period. Treatment 5 was unusual in producing high temperatures during the first 20 days (similar to Trt. 1) but then exhibiting temperatures lower than Trt. 1 during the last half of the study, although the temperatures were still the highest of all covers except Trt. 1.

All minimum temperatures were similar but with a differential of about 3°F (Fig. 2). Treatment 1 provided slightly higher minimum (night) temperatures than all other treatments. The night temperatures under Trt. 5 were lower than Trt. 1 during the middle third of the growing period but were similar to Trt. 1 during the initial and final stages. A rather low night temperature was exhibited by Trt. 6 during the first 10 days but thereafter were similar to those under the other experimental covers. All covers retained heat during the night as evidenced by their temperatures being higher than air temperature.

Although Trt. 1 tended to germinate and produce the most plants, there were no significant differences among the treatments (Table 1).

There were no differences in the number of optimum transplants among treatments during the first two pullings (Fig. 3). Thereafter, Trt. 1 consistently produced greater numbers of optimum transplants than the other treatments. Other than Trt. 1, there were no differences among treatments during that period.

Results for the number of usable transplants (Fig. 4) were similar to the number of optimum transplants. However, the differential between Trt. 1 and the other treatments was greater than for optimum transplants suggesting that the plastic grown plants (Trt 1) tended to be more spindly than plants produced under other covers.

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PLOT OF PMAX*DAY SYMBOL IS VALUE OF TRT

Trt. 1-7: described in text.
Trt. 8: air temperature.

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Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

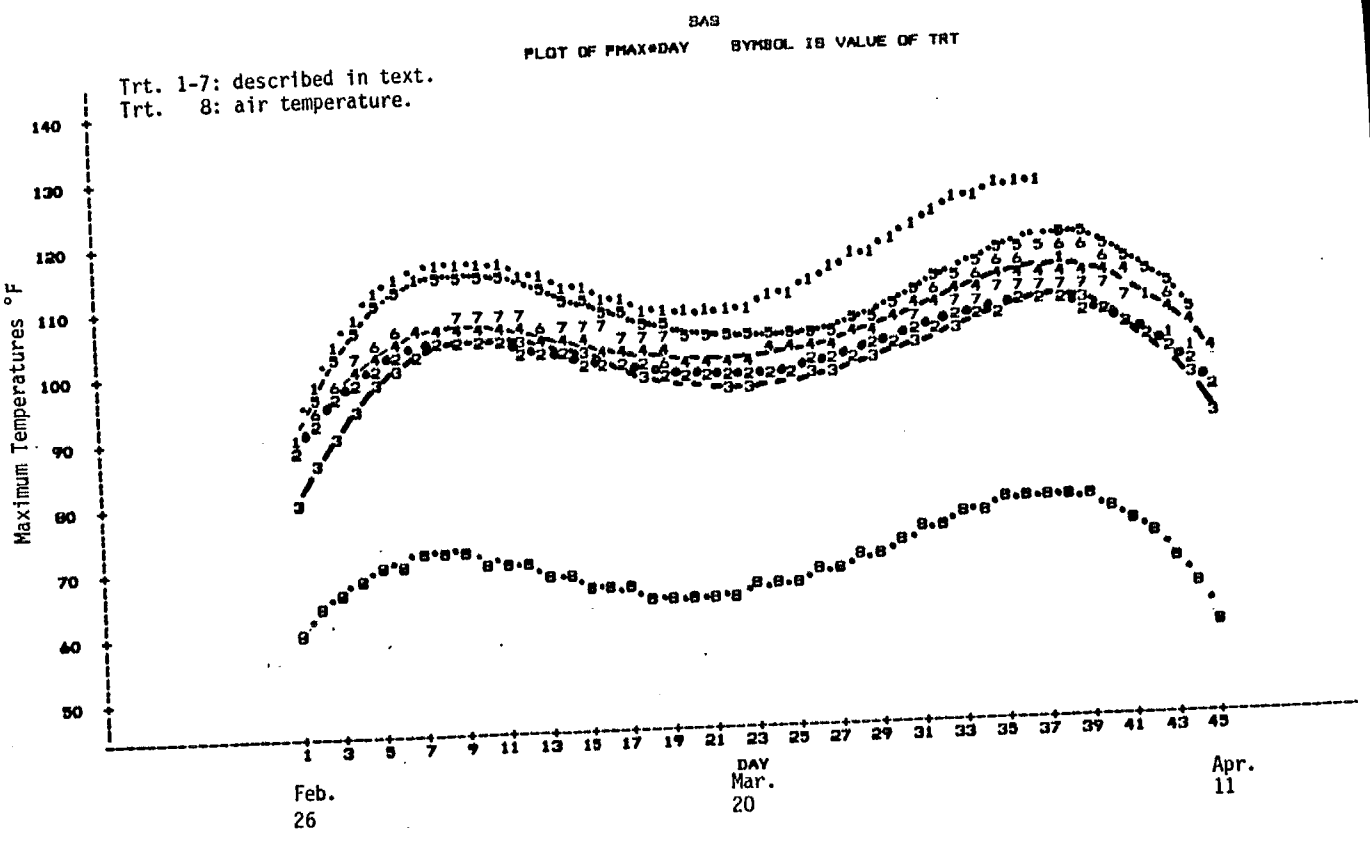

Fig. 1. Effect of type of plant bed cover on maximum temperatures under covers during tobacco germination and seedling growth; BBTRS, 1985.

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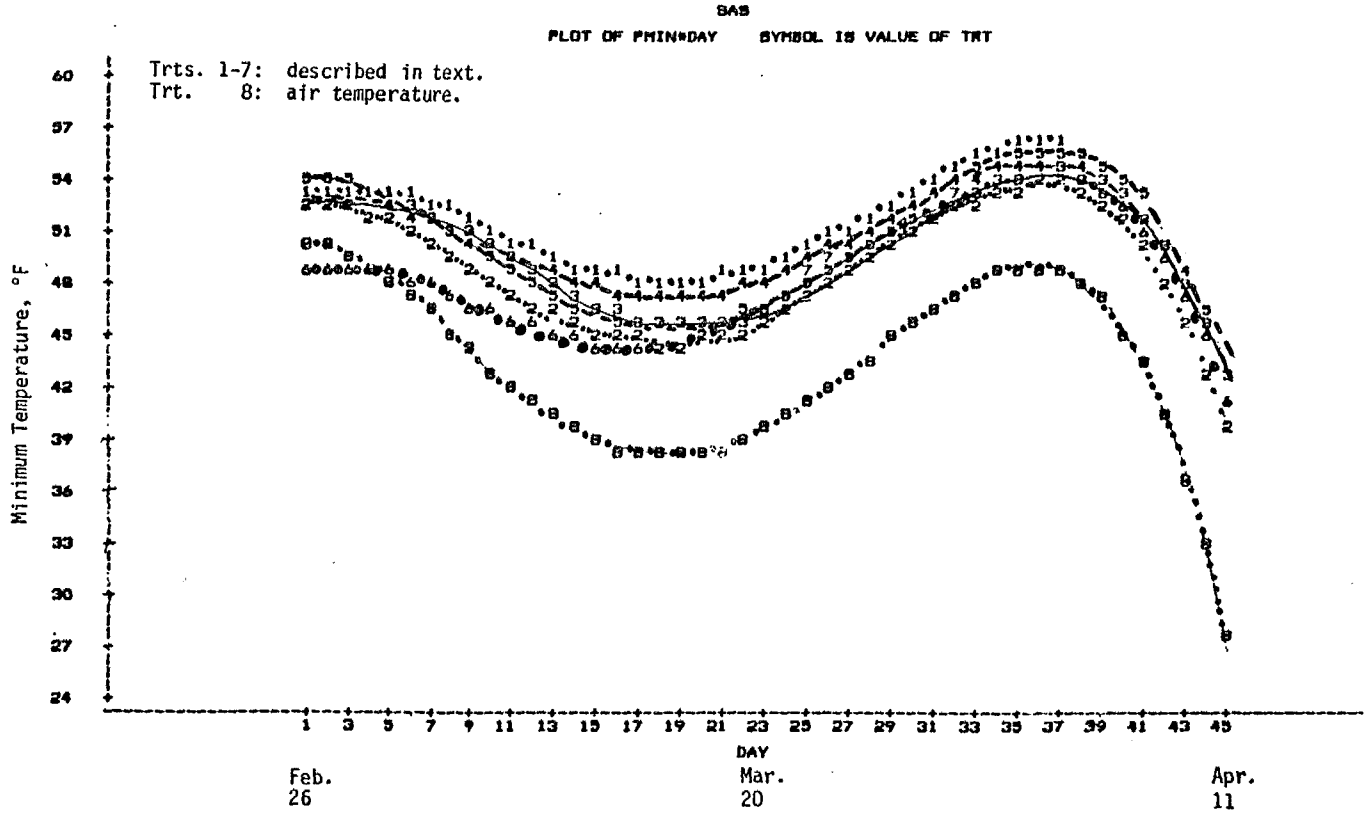

Fig. 2. Effect of type of plantbed cover on minimum temperatures under covers during tobacco germination and seedling growth; BBTRS, 1985.

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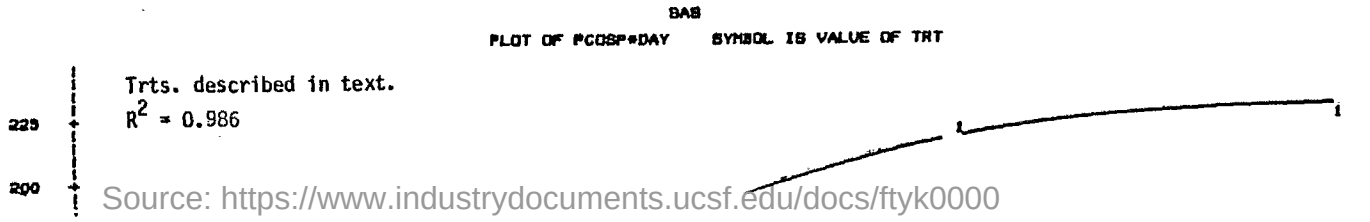

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Fig. 2. Effect of type of plantbed cover on minimum temperatures under covers during tobacco germination and seedling growth; BBTRS, 1985.

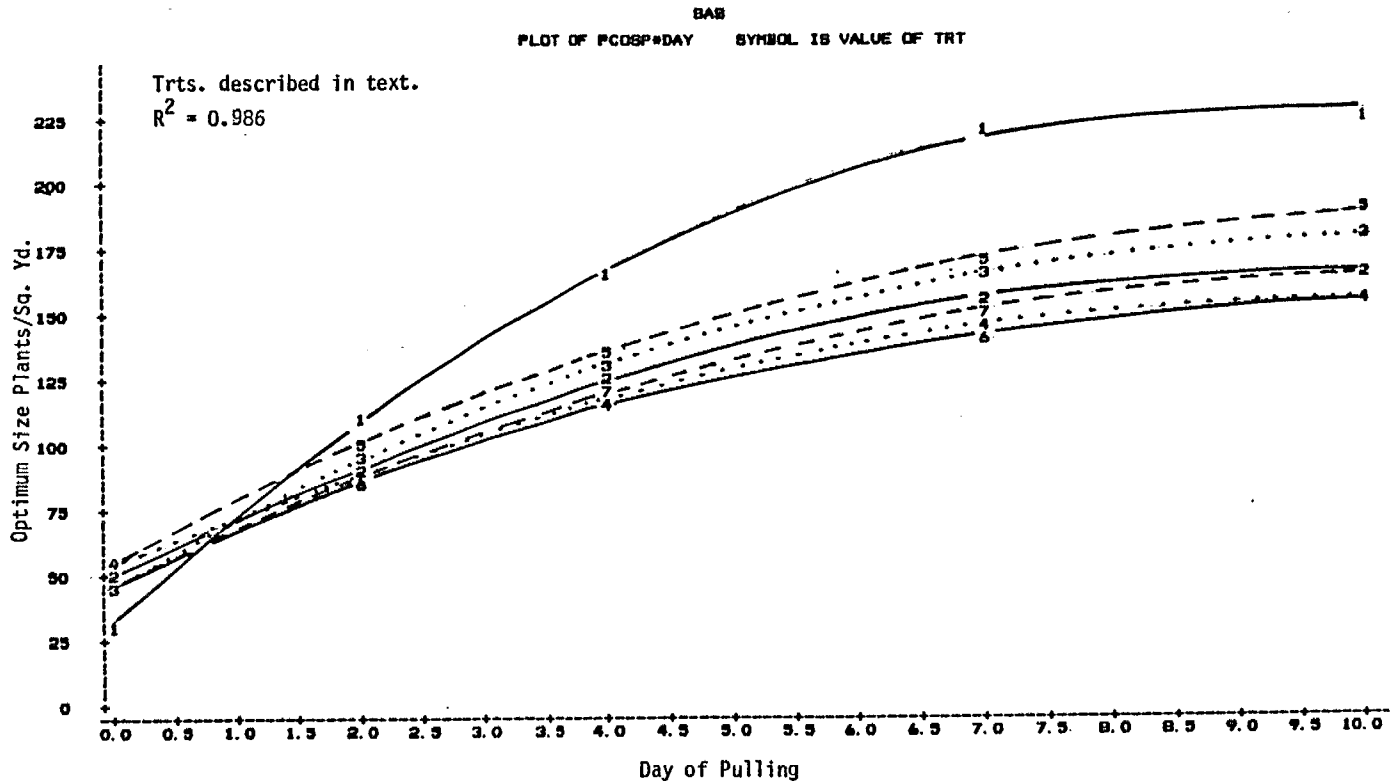

Fig. 3. Effect of type of plant bed cover or cumulative number of optimum size plants pulled over a 10-day period; BBTRS, 1985.

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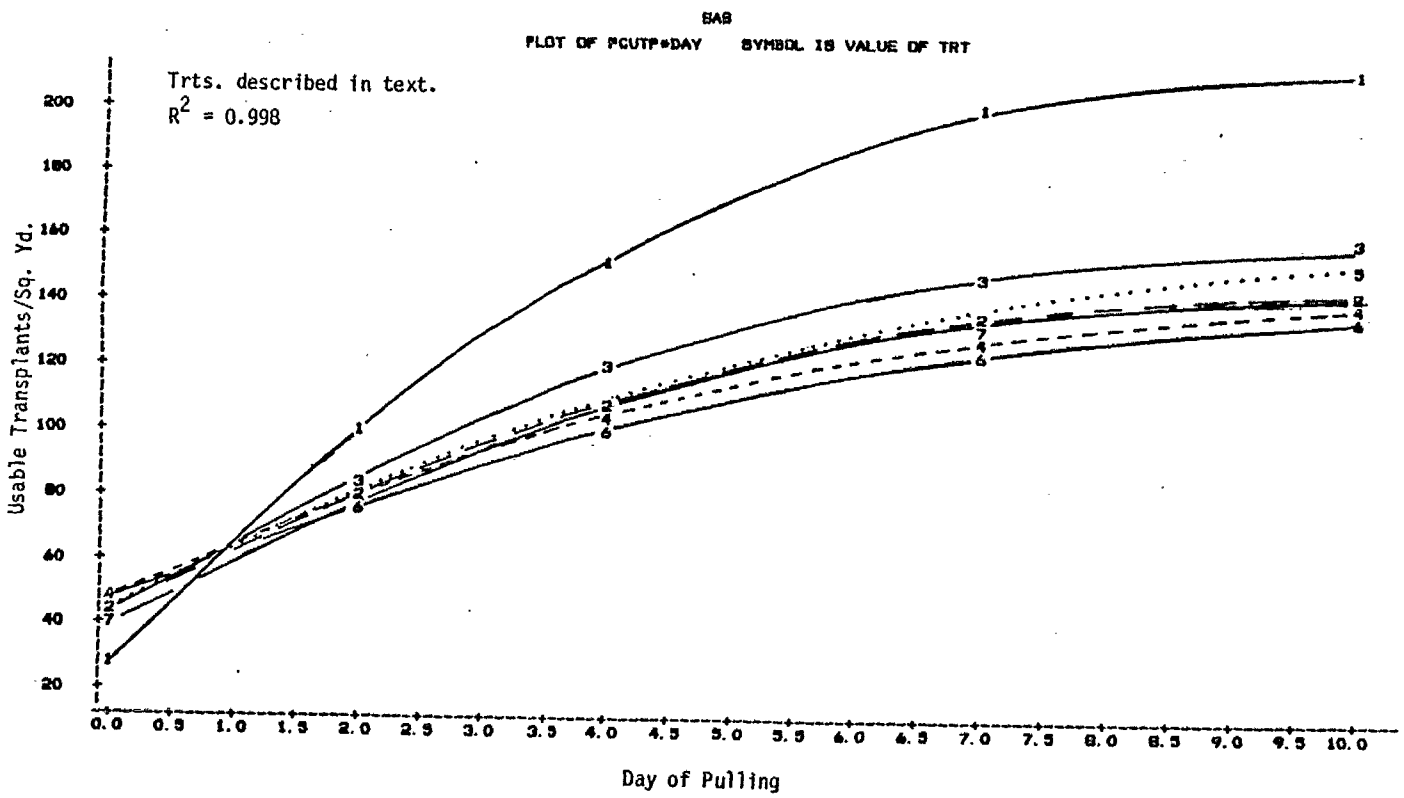

Fig. 4. Effect of type of plant bed cover on cumulative number of usable transplants pulled over a 10-day period; BBTRS, 1985

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Trt.	Plan Produ	Tot
1	418	
2	322	
3	358	
4	306	
5	361	
6	314	
7	299	
CV(%)	23.0	

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Table 1. Effect of different plant bed covers on total plants produced by the end of the transplant pulling period, and the number of optimum size plants, usable plants, and large plants produced during a 10-day pulling period.1/

Trt.	Total Plants Produced	Optimum Size Plants	Usable Plants	Large Plants
1	418 a2/	230 a	214 a	241 a
2	322 a	166 b	146 b	204 abc
3	358 a	180 b	162 b	200 abc
4	306 a	154 b	141 b	182 c
5	361 a	189 b	152 b	238 ab
6	314 a	154 b	136 b	199 bc
7	299 a	166 b	146 b	190 c
CV(%)	23.0	12.1	11.4	12.2

1/ All numbers based on 1 sq. yd.

2/ Means with the same letter are not significantly different at $p \leq 0.05$.

Interestingly, Trt. 5 produced significantly more large plants at the first pulling than Trt. 1 (Fig. 5). There were no differences among treatments at the second pulling but, thereafter, Trts. 1 and 5 produced greater numbers of large plants than the other treatments (covers). These data suggest that the covers in Trts. 2-7 produced more uniform plants at the first pulling than did the plastic cover and, further, that it should be possible to start pulling earlier under Trts. 2-7 because of the availability of plants 10 cm in length. Once pulling began, however, Trt. 1 converged with Trt. 5 whereas the other treatments diverged from Trt. 5.

Conclusions. Treatments 3, 4, 6, and 7 held little or no advantage over Trt. 2 either in terms of higher maximum temperature during germination, lower maximum temperature just before pulling for transplanting, higher minimum (night) temperatures during germination and early seedling growth, or in the production of usable-sized transplants.

In general, the experimental covers, as well as the commercially available ones, were cooler (both day and night) than the plastic cover. However, Trt. 5 produced early temperatures similar to plastic and exhibited lower maximum temperatures during the period when plants were growing rapidly, daytime temperatures were increasing, and the danger of plant scalding imminent when plants touched the plastic. That, coupled with the fact that Trt. 5 produced many large plants early as well as produced the same number of large plants during the pulling period as did the plastic cover suggests that Trt. 5 may be an excellent compromise between the advantages and disadvantages of both plastic and synthetics such as Reemay. Further, if covers such as Trts. 5 and 7 have good stability characteristics that would allow them to be used several years, the lower annual cost would make their use attractive.

Restricting Shoot Elongation of Tobacco Transplants with Alar (R. C. Long)

This study, begun in 1984, was designed to test the theory that Alar application would provide more uniform transplants, by restricting shoot

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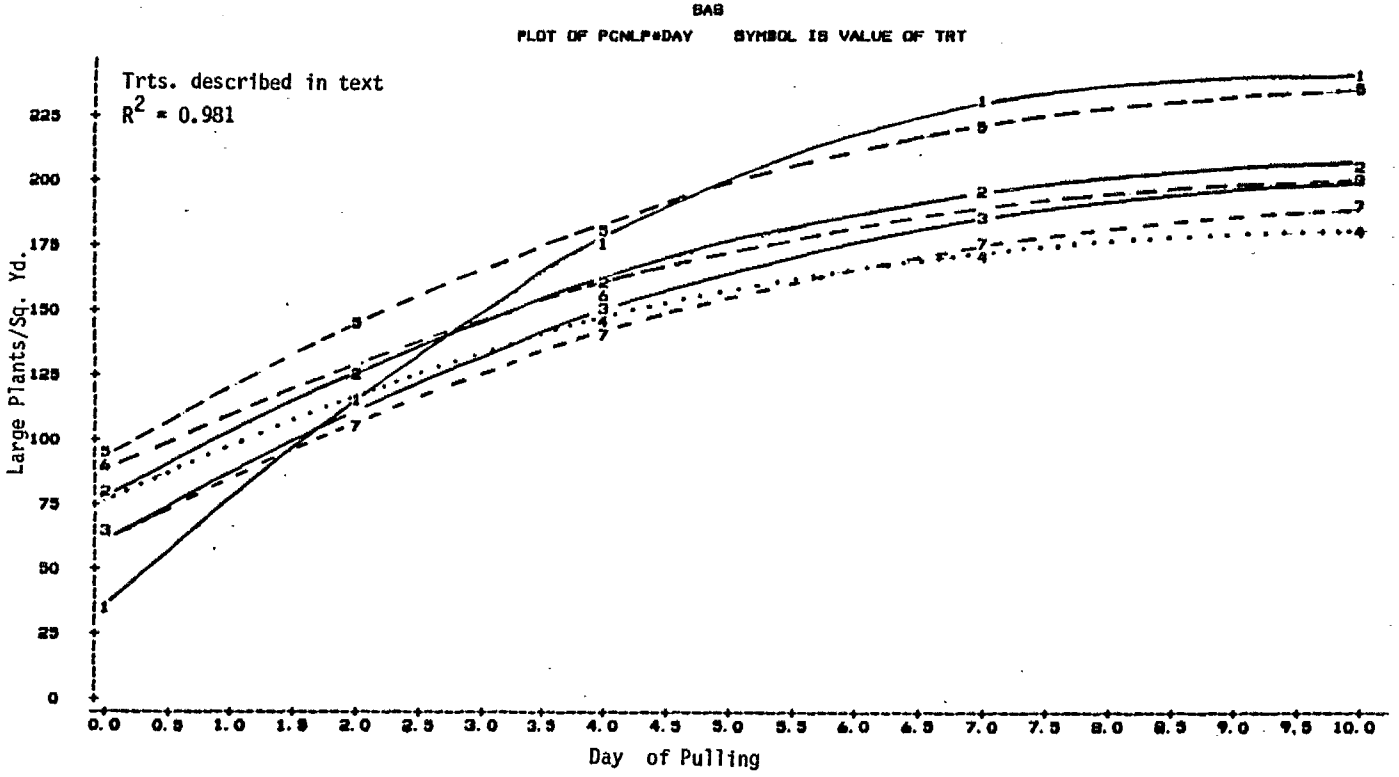

Fig. 5 Effect of type of plant bed cover on the cumulative number of large plants pulled over a 10-day period; BBTRS, 1985.

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elongations in the plantbed, without adversely affecting yield or quality.

McNair 944 plantbeds were grown at the Border Belt Tobacco Research Station in a randomized complete block design with four replications as in 1984. Three treatments were established: a) check, b) early application (EA) on 4/9/85, or c) late application (LA) on 4/17/85. Alar at 4000 ppm was sprayed on the beds to the point of run-off.

On April 22, a 1 sq. ft. area from each bed was pulled clean. The stem length of each plant was classified as: a) small, 10 cm length; b) optimum, 10-17 cm; c) large, 17 cm. Optimum sized transplants from each treatment were planted into the field. A second pulling from a separate 1 sq. ft. area was made on April 26. The data are given in Tables 1 and 2.

Table 1. Mean Percentage of Total Plants in Each Size Category on April 22

Size Category	Treatment		
	Check	LA	EA
Small	50.6	51.9	68.0
Optimum	26.8	38.0	29.1
Large	22.2	10.1	2.9

Table 2. Mean Percentage of Total Plants in Each Size Category on April 26

Size Category	Treatment		
	Check	LA	EA
Small	16.3	31.3	35.6
Optimum	14.0	23.5	44.8
Large	69.6	45.1	20.7

The data in Table 1 confirms the fact that Alar suppressed shoot elongation. The early application (EA) produced about the same percentage of optimumm sized transplants as the check treatment at the first pulling. But, most importantly, the percentage of small plants was much greater and the percentage of large plants was much smaller than the check, which showed up in the later pulling (Table 2) as a much higher percentage of optimum sized plants than the check. The late application tended to restrict shoot elongation but not to the extend that did the EA treatment. These results are very similar to those obtained in 1984.

There were no differences in yield and quality index among treatments. The reducing sugar and nicotine concentrations of the LA treatment were slightly lower and higher, respectively, than the other treatments. Again, the early application flowered slightly earlier than the late application or the check.

Transplant Production Methods (R. C. Long and T. A. Bartholomew)

During preliminary studies the past several years, the production of transplants under greenhouse conditions using the Techniculture plugs or Paperpot honeycomb cells has produced promising results. A study was designed to test the production of transplants under those conditions and the resultant yield and quality of those plants compared to traditionally produced bare-root

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transplants.

Speight G-28 was seeded in standard plantbeds on 2/14/85. Techniculture plugs (4 x 1.9 cm dia.) and the Paperpot honeycomb cells (Type 305; approximately 3 x3 cm dia.) filled with Terra-Lite Metro-Mix 220 were seeded with pelleted seed on 3/4/85 and placed in the greenhouse. Plant growth in the plantbeds was as expected. However the growth of the seedlings in the plugs and honeycomb cells was much poorer than previously observed and caused them to be delayed in transplanting until 5/9/85, whereas the bare-root seedlings were transplanted on 5/2/85.

Subsequent plant growth of the plug treatment was adequate but the honeycomb cell-grown plants were very slow in initiating field growth. Several plants of the latter were dug from the soil after several weeks and it was noted that the paper cell had not disintegrated which probably accounted for the poor growth and yellow color of the plants. Finally, however, root growth extended beneath the paper sleeve and, coupled with disintegration of the paper, plant growth was rapid thereafter.

However, neither the plug nor the honeycomb cell-grown plants caught up with check plants. Consequently, the bare-root transplant treatment flowered earlier, produced higher yield and quality index, and had more acceptable sugar and nicotine concentrations than the other treatments.

Clearly, additional work is necessary to identify the type of paper cells that will disintegrate at the appropriate time and other conditions that are necessary for the production of tranplants in the greenhouse if these types of systems are to be of value.

Production and Curing of Non-Traditional Types (R. C. Long, D. A. Danehower and Kimball Brock)

Several tobacco types, not traditional to North Carolina, were grown to determine how they might be cured under the environment at the Border Belt Research Station as compared to a standard flue-cured variety.

Amerlinha, Galpao, "Brazil Special" (ancestry unknown), and McNair 944 were grown using standard cultural practices for flue-cured production. As the leaves ripened, they were harvested, strung on sticks, and placed in three stick barns for air-curing. The curing treatment differences among the barns were: 1 pilot light, 2 pilot lights, or 3 pilot lights in the barns to provide heat to prevent molding of the leaves before they cured out.

As expected, the barns with either 2 or 3 pilot lights cured the tobacco progressively faster than did only 1 pilot light; there was about an 8°F difference between each barn. Consequently, those tobaccos were flashy and closely resembled flue-cured tobacco. The slow cured tobacco was darker in color but still not as dark as had been hoped. It appears that modification of the curing facility to provide greater air flow and lower temperatures will be necessary before a true air-cured type can be obtained.

In a related effort, Samsun, an oriental type, was grown at flue-cured population but under the base fertilizer application rate (30 #N/A). Leaves were harvested about 10 days before ripeness, strung on sticks, and sun-cured

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for 5 days thereafter. The sticks were placed in the shade for continued curing until cured and dry (∿ additional 7 days). This tobacco cured out darker than was obtained in 1984 when the curing occurred in the sun for 12 days which probably bleached some of the color from the leaves. Both the dark color and the aroma obtained in 1985 was typical of oriental tobacco. Neutral volatiles and other chemical analyses will be performed to compare these tobaccos with oriental tobacco.

Production of Tobacco for Protein and Biomass (R. C. Long and T. A. Bartholomew)

A number of studies were continued at the Border Belt Tobacco Research Station: genotypes, no covers/non-fumigated seeding, and plant populations.

Plant growth and season yields of the fumigated, plantbed cover treatments was very good and consistent with previous results. Several new genotypes were tested and found to be similar in biomass production to others such as Speight G-28.

Poor plant growth occurred when seeding was made to non-fumigated plots not covered with plantbed covers. One less harvest was obtained with this system compared to the standard system and total biomass yield was reduced significantly.

Hollow stalk rot continues to be a periodic problem at certain times during the growing season. Greenhouse grown seedlings were transplanted into several plots following tilrovating of the beds after the second harvest as a possible means of escaping the disease problem. Reasonably good growth of the second planting was obtained but biomass yields were poorer than expected. Additional work is needed to find means of circumventing the disease problem.

GRADUATE STUDENTS:

Bartholomew, T. A. (U.S.A.), M.S., under R. C. Long
Felipe, E. (Venezuela), M.S., under R. C. Long
Goenaga, R. J. (U.S.A.), Ph.D., under R. C. Long and R. J. Volk
Wan Mamat, Zaki (Malaysia), M.S., under R. C. Long

PUBLICATIONS:

Felipe, E. F, and R. C. Long. Management of flue-cured tobacco under excess nitrogen. (In review; to be submitted to Tob. Sci.).

THESIS:

Felipe, E. F. 1985. Management of flue-cured tobacco under excess nitrogen. M.S. Thesis, Crop Science Department.

PAPERS PRESENTED AT PROFESSIONAL MEETINGS:

Danehower, D. A., Long, R. C., and Weeks, W. W. 1985. Influence of Genotype, Ontogeny, and Curing on Cis-Abienol Levels. 39th Tobacco Chemists' Research Conference, Oct. 2-5, 1985. Montreal, Canada.

2000270216

Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

Title: NC 05563 - Burley Tobacco Breeding and Genetics

Project Leader: Rebeca C. Rufty

1. Summary of Research:

A. Breeding for Virus Resistance (with G. V. Gooding, Jr. and E. A. Wernsman)

Sources of resistance to tobacco etch virus (TEV) and tobacco vein mottling virus (TVMV) continued to be evaluated under field conditions in 1985. Greenville 136, a new breeding line developed in Tennessee, was found to have a high level of resistance to both viruses. This line was hybridized with several burley cultivars and resulting F2 populations will be evaluated for virus resistance in 1986. Several virus-resistant F2 selections were made in 1985 from crosses of Greenville 131 and commercial cultivars. F3 families derived from F2 resistant plants will be further evaluated in 1986.

The cultivar Havana 307 was evaluated as an additional source of virus resistance. F1 hybrids of Havana 307 x Ky 14 and Havana 307 x MB (FV) were subjected to the anther culture procedure to produce haploids. Following greenhouse inoculations, 103 haploids were found to be virus-resistant. Chromosome doubling procedures were then used to obtain fertile, dihaploid lines and these will be evaluated in the field in 1986. The mechanism of virus resistance in Havana 307 was elucidated using generation means analysis of greenhouse-inoculated parental, F1, and backcross generations. It was estimated that virus resistance is controlled by 2 co-dominant or additive loci.

B. Breeding for Black Shank Resistance

Breeding lines and commercial cultivars were evaluated for black shank (Phytophthora parasitica var. nicotianae) resistance in a disease nursery located in Rocky Mount, N. C. Certain lines were selected as having superior black shank resistance to that found in commercial cultivars. Selected lines will be evaluated for agronomic characteristics at the Upper Mountain Research Station in 1986.

C. Breeding for Blue Mold Resistance (with E. A. Wernsman and C. E. Main)

Flue-cured and burley tobacco germplasm continues to be evaluated for blue mold (Peronospora tabacina) resistance. Test plots were established at Laurel Springs, N.C. and Gurabo, Puerto Rico. As in previous years, blue mold did not develop in North Carolina but disease development was good in Puerto Rico.

Four flue-cured lines with apparent blue mold resistance had been selected in previous years. These lines were further evaluated in Puerto Rico in 1985. Three breeding lines labeled DH 17, DH 42 and DH 62 were found to be highly tolerant to blue mold and differed significantly from susceptible commercial cultivars. F1 hybrids between the breeding lines and the commercial cultivars had intermediate levels of resistance.

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Evaluations for yield and quality of blue mold resistant lines and commercial cultivars were made at the Border Belt Research Station, Whiteville, N.C. In general, the resistant lines were lower yielding than the commercial cultivars. The yield of breeding line DH 42, however, did not differ significantly from the yield of McN 944.

Forty burley breeding lines derived from crosses of Ky 15 x Ovens 62 and Ky 17 x Ovens 62 were also evaluated for blue mold resistance in 1985. Highly significant differences for blue mold reaction were found among entries. Four breeding lines were selected on the basis of low disease incidence and these will be further evaluated in 1986. These lines represent the first time burley genotypes have been identified as potentially having blue mold tolerance.

D. Studies on the Effect of Ozone on Burley Tobacco in the Presence and Absence of Tobacco Etch (TEV) and Tobacco Vein Mottling Viruses (TVMV) (with Richard A. Reinert)

"Weather fleck" caused by high levels of atmospheric ozone (O_3) is believed to be more severe on burley tobacco infected with above viruses. The hypothesis of a possible O_3-virus interaction is being tested in a controlled, greenhouse exposure system. Burley cultivars Burley 21, Burley 49 and Greenville 131, differing in O_3 and virus sensitivity, were infected separately with TEV or TVMV and exposed to increasing concentrations of O_3 (0.0, 0.5, 0.1, 0.2 and 0.4 pm) daily, 3 hrs per day, 5 days a week for 3 weeks. Both viruses may produce symptoms resembling weather fleck on specific cultivars. There was no significant virus-O_3 interaction with TEV across cultivars. Tobacco vein mottling virus enhanced damage caused by O_3 on Burley 21 and Greenville 131, but not on Burley 49. Ozone concentrations will be monitored under field conditions in 1986 on virus inoculated and virus-free plots.

II. Graduate Students:

Wannamaker, Mary Jo. Ph.D. candidate, Crop Science. Genetic investigations on the angular leaf spot disease of tobacco caused by Pseudomonas angulata.

IV. Publications:

Gooding, G. V., Jr., Wernsman, E. A. and Rufty, R.C. 1985. Reaction of Nicotiana tabacum L. cultivar Havana 307 to potato virus Y, tobacco vein mottling virus, tobacco etch virus and Peronosora tabacina. Tob. Sci. 29:32-35

Rufty, R. C., Wernsman, E. A., and Gooding, G. V., Jr. 1985. Evaluation of tobacco haploids for resistance to TMV, PVY, and Meloidogyne incognita using detached leaves. Phytopathology 75:1335. (Abstract).

2000270218

Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

VI. Manuscripts in Review

Rufty, Rebeca C., Wernsman, E. A., and Gooding, G. V., Jr. 1986. Inheritance of resistance to tobacco etch virus in Nicotiana tabacum L. cultivar Havana 307. Phytopathology: (In review).

Rufty, Rebeca C., Wernsman, E. A., and Gooding, G. V., Jr. 1986. Evaluation of tobacco haploids and doubled-haploids for resistance to tobacco mosaic virus, Meloidogyne incognita, and Pseudomonas syringae pv. tabaci using detached leaves. Phytopathology: (In review).

Gooding, G. V., Jr. and Rufty, Rebeca C. 1986. Identification and characterization of strains of tobacco etch virus and tobacco vein mottling virus in North Carolina. Plant Disease: (In review).

VII. Papers Presented at Professional Meetings:

Rufty, Rebeca C., E. A. Wernsman and G. V. Gooding. 1985. Inheritance of Resistance to Blue Mold. The 31st Tobacco Workers' Conference. January 7-10, 1985. Pinehurst, N.C.

Wernsman, E. A., and R. C. Rufty. 1985. Genetic Information in Different Haploid Nuclei of Inbred Plants. The 31st Tobacco Workers' Conference. January 7-10, 1985. Pinehurst, N.C.

IX. Acknowledgements

I thank the North Carolina Tobacco Foundation, Inc. and R. J. Reynolds Tobacco Co. for financial support. Appreciation is expressed to Dan Wall for technical assistance.

2000270219

Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

Title: NC 05469 Tobacco Breeding for Germplasm and Varieties Resistant to Pests and Advantageous to Health

Project Leader: G. R. Gwynn

I. Summary of Research:

A. Insect Resistance: Fifty-five breeding lines, most of which were in the F_5 stage of inbreeding, were planted in field experiments in Tifton, Georgia and Oxford, North Carolina in 1985. Data on natural infestation of budworms and hornworms on first growth and regrowth after cut-off were taken at Tifton while data on larval performance after artificial infestation were taken at Oxford. Several lines were identified as being worthy of release as resistant germplasm and one of these, line G5-14, will be proposed for release. Line G5-14 is an F_5 breeding line from TI 165 by NC 82. Table 1 presents some of the data on this line and certain checks.

Table 1. Performance of Breeding Line G5-14, its resistant parent TI 165, and NC 2326 check in budworm and hornworm tests at Tifton and Oxford.

Entry	Oxford					Tifton			
	Larval Wt.[1/] (mgms)		No. surviving[1/]		GH Feeding Trial No. Surv.[3/]	% Natural Infestation			
						Budworm		Hornworm	
	1985	1984	1985	1984		1985[2/]	1984[4/]	1985[2/]	1984[4/]
G5-14	45 hi	31 kl	2.75 ab	2.87 a-c	6.4 e	4.7	4	16	9
TI 165	53 g-i	44 j-l	2.13 ab	2.75 a-c	10.4 a-e	1.9	7	11	100
NC 2326	270 a	87 a-c	3.50 a	3.75 a-c	11.6 a-d	39.0	75	37	100

1/
2/ mean of five larvae on each of five plants - eight replicates
3/ ten replicates
4/ mean number surviving from 25 applied
four replicates

B. Breeding for Lower Phenol Levels: Seven tobaccos were crossed with flue-cured Speight G-28 and used to set up seven genetic populations for study in 1984 and 85. The objective was to see if the populations could (1) furnish genetic material that was lower in total polyphenol content and certain constituent polyphenols and (2) provide information on the nature of genetic variation. Speight G-28 was selected based on earlier studies as the

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lowest polyphenol producing flue-cured variety studied and the other entries were similarly selected. They were burley types B 37 and L 8, turkish types TI 1018, TI 1237 and TI 1326, pale-yellow Va. Bright and primative TI 1281.

The two parents and the F_1 and F_2 generations of crosses between Speight G-28 and each of the seven non-flue-cured types were arranged in a split-plot design with three replications at Reidsville in 1984. Flue-cured cultural practices were used and the center stalk position harvested, cured and analyzed by HPLC. Samples were also analyzed for total polyphenol determinations by colormetric and NIR reflectance. Generation mean analysis was performed on the 1984 data but analyses of 1985 data is not yet available. Table 2 shows parental, F_1 and F_2 means by families for total chlorogenic acid, one of the more important constituent polyphenols. The consistency of Speight G-28 across families indicates the repeatability of the results. With the exception of TI 1237 and TI 1326 the non-flue-cured parents were considerably below Speight G-28. F_1 and F_2's were very similar indicating the likelihood of dominance. The F_1 of TI 1326 was higher in chlorogenic acid than the F_2. Table 3 shows estimates of additive and dominant effects by families for total polyphenols estimated by each of three methods together with total chlorogenic acid and rutin. There are differences among families. In most cases the three methods of determining total polyphenol lead to similar conclusions regarding effects but there are exceptions (note families 5-7). The TI 1237 family appears to have little genetic variability.

Table 2. Percent total chlorogenic acid (dry weight) - mean values of parents, F_1, and F_2 generations by families - 1984 crop.

	Family						
TCA	1	2	3	4	5	6	7
% D.W.	B37	L8	Va.Bright	TI1018	TI1237	TI1281	TI1326
Speight G-28	2.25a[2/]	2.34a	2.14a	2.17a	2.15a	2.20a	2.24ab
Parent 2[1/]	.33c	.05c	.30c	.46b	1.65b	.35c	1.32c
F_1	1.75b	2.17ab	1.77b	2.36a	2.28a	1.46b	2.88a
F_2	1.72b	1.87b	1.68b	2.19a	2.30a	1.90ab	1.99bc

1/ Parent 2 refers to whatever parent is listed in column head.

2/ means with the same letter, within families are not significantly different. Waller-Duncan K Ratio = 100.

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Table 3. Additive and dominant effects by families and constituents - 1984 crop.

Constituent		Family 1 B37	2 L8	3 Va.Bright	4 TI1018	5 TI1237	6 TI1281	7 TI1326
TPP(C)[1/]	a[2/]	1.13**	1.55**	.97**	.99**	-.18	1.05**	.33
	d	.99*	1.70**	1.03*	2.08**	.44	.63	2.04**
TPP(LC)	a	1.25**	1.44**	1.05**	1.07**	-.03	.95**	.41*
	d	.62*	1.16**	.93**	1.31**	.25	.58	1.27**
TPP(NIR)	a	1.40**	1.85**	.93**	1.21**	1.07**	1.32**	1.00**
	d	1.62**	2.04**	1.35**	1.52**	1.40**	1.27**	.64
TCA	a	.96**	1.14**	.92**	.87**	.24	.92**	.44**
	d	.49	1.01**	.58*	1.12**	.41	.27	1.04**
RUTIN	a	.29**	.28**	.14*	.21**	-.17	.09	0
	d	.11	.14	.30**	.15	-.11	.31**	.20*

1/ TPP = total polyphenol; TCA = total chlorogenic acid; C,LC,NIR = colorimetric, liquid chromatography, and near-infrared respectively.

2/ a = additive effects; d = dominance effects

3/ *,** significantly different from zero at the .05 and .01 level of probability respectively - T test.

C. Breeding for Bacterial Wilt Resistance: One approach to increased wilt resistance has been to combine several known sources of resistance such as 448A, DSPA, Enshu, 79A, 79X, etc. Two experiments were conducted on lines from these crosses in Lenoir county in 1985 on a disease site. K 399 was used as the resistant check. In one group, 14 of 24 lines were as low or lower in percent diseased as K 399. In the other group which was basically the same material except more advanced in inbreeding, 30 of 64 entries were as low or lower than K 399 in percent diseased.

An experiment involving dihaploids developed for wilt resistance was conducted at two locations in Lenoir county in 1985. The parential sources for the dihaploids were F_1 hybrids between released flue-cured cultivars and/or advanced breeding lines. Dihaploids were paternally derived. K 399 was 43% and 39% diseased at the two locations and of the 60 dihaploids tested eight were diseased 25% or less at one location and 14 at the other. In agronomic tests none of the high wilt resistant dihaploids compared well with the checks indicating that either more dihaploids have to be tested or some other procedure used in order to combine wilt resistance and desirable agronomic performance.

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Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

D. Disease and Insect Resistance from Nicotiana repanda: Thirty-eight breeding lines in various stages of inbreeding from crosses of flue-cured cultivars and breeding lines with N. repanda germplasm were tested in 1985 on a cyst-nematode infested nursery at Blackstone, Virginia. Soil samples at planting and at the end of harvest (late August) were assayed for nematode eggs, cysts and larvae. Checks were NC 7567, Coker 319 and M1 (one of the resistant sources). Considerable rep to rep variability existed resulting in high C.V.'s. Nevertheless, some entries compared favorably with the resistant check NC 7567.

Breeding material from N. repanda backcrosses on to flue-cured cultivars was tested at Oxford for resistance to TMV. Resistance of a local lesion type is being carried in the material but we do not have a true-breeding resistant line as yet. The material has a necrotic spotting similar to resistance from N. glutinosa but it tends to become systemic much quicker and innoculated leaves must be removed earlier than with N. glutinosa in order to save the plant.

Thirty-four breeding lines containing repanda germplasm were planted at Tifton, Georgia and evaluated for hornworm resistance in 1985. Most entries trace to one source. There appeared to be little hornworm resistance in this group although a few entries appeared to be less damaged than the susceptible check. N. repanda was damaged very little.

E. Release of Flue-cured Cultivar NC 60: Breeding line NC 60, tested as NC 2060, was approved for release by the Flue-cured Variety Evaluation Sub-committee, and the Breeders' Release Board of NCSU. This line may be increased in 1986 and offered for planting in 1987 as an F_9. It resulted from a cross of McNair 944 and Speight G-28. It will be rated high in resistance to black shank and bacterial wilt (like Speight G-28) and it is resistant to Meloidogyne incognita races 1 and 3. Its yield in the N. C. Official Variety test at 3142 pounds per acre was not significantly different from K 326 at 3337. It has good quality and price characteristics and received high usability ratings by tobacco companies.

IV. Publications:

Gwynn, G. R., R. F. Severson, D. M. Jackson and M. G. Stephenson. 1985. Inheritance of sucrose esters containing β-methylvaleric acid in tobacco. Tob. Sci. 29:79-81.

Gwynn, G. R. 1985. Registration of 'NC 85' tobacco. Crop Science 25: p. 573.

V. Manuscripts Accepted for Publication:

Arrendale, R. E., R. F. Severson, O. T. Chortyk and G. R. Gwynn. Alkaloid development in normal and converter tobaccos. Tob. Sci.

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Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

V. Manuscripts in Review:

Gwynn, G. R., K. R. Barker, J. J. Reilly, D. A. Komn and S. M. Reed. Genetic resistance to tobacco mosaic virus, cyst nematodes, root knot nematodes and wildfire from Nicotiana tabacum L. Plant Disease.

Gwynn, G. R. Registration of 'NC 60' tobacco. Crop Science.

Jackson, D. M., R. F. Severson, A. W. Johnson, G. R. Gwynn, J. F. Chaplin, V. A. Sisson and G. A. Herzog. Host plant resistance in tobacco to Heliothis spp. S-59 Workshop "Emerging Control Tactics and Techniques of Heliothis."

VII. Papers Presented at Professional Meetings:

Gwynn, G. R., R. E. Williamson, and M. E. Snook. Genetics and breeding of total and constituent polyphenols in tobacco. 39th Tobacco Chemists' Research Conf.

IX. Acknowledgements:

Appreciation is expressed to Mrs. E. H. Brummitt, Mr. B. H. Bunn, Mr. R. M. Critcher and Mrs. J. D. Hardee for valuable technical assistance.

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Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

Title: NC 05545 Genetic Investigations of Tobacco and the Nicotiana Species

Project Leader: V. A. Sisson

I. Summary of Research:

Project Objectives:

a) Investigate the genetics and breeding behavior of Nicotiana species and hybrids for enhancing tobacco germplasm.
b) Provide information on the genetic variability of chemical and morphological traits related to improved tobacco safety, improved quality, and disease and insect resistance.
c) Identify and incorporate molecular markers into tobacco germplasm for use in fundamental genetic investigations.

A. Leaf Chemistry of the Nicotiana species.

In 1983 a study was initiated with the goal of developing a chemical profile of each species in the Nicotiana genus. This information has potential value for understanding and elucidating phylogenetic relationships among the wild relatives of tobacco, as well as, in identifying germplasm for favorably altering the chemistry of tobacco. We previously described the alkaloid and polyphenol composition of the individual Nicotiana species. Analyses of the long chain, aliphatic hydrocarbon compounds which contain from 25 to 36 carbon atoms have now been completed. These hydrocarbons along with diterpenes, fatty alcohols and sugar esters make up the major cuticular components of green tobacco. Hydrocarbon levels ranged from a low of 4 $\mu g/cm^2$ for N. longiflora to 72 $\mu g/cm^2$ for N. cordifolia. Other species with low hydrocarbon levels included N. exigua, N. bonariensis, N. plumbaginifolia, N. acuminata, N. corymbosa, N. linearis, and N. miersii. In addition to N. cordifolia, species with high levels of hydrocarbons were N. glauca, N. excelsior, N. acaulis, N. fragrans, N. debneyi, N. benthamiana and N. nudicaulis. Hentriacontane (C31H64), the C31 hydrocarbon, was by far the most characteristic hydrocarbon fraction among the species. Likewise, the normal isomeric configuration of each hydrocarbon fraction occurred in the greatest quantity, although, the iso and anteiso configurations were found for most fractions. Hydrocarbon levels and their relative distributions were found to correspond with taxonomic groupings of the Nicotiana species, but there were numerous exceptions. The major taxonomic subdivisions are related to geographic distribution of the species and reflect the evolution of the various species groups in different environments or habitats. The chemical profile of individual species most likely reflects the different natural forces that have impacted on their evolution.

B. Isozyme Studies of the Nicotiana Species.

A survey of isozymic variation was carried out on the 64 different species in the USDA's Nicotiana species collection. Four isozyme systems were examined using starch gel electrophoresis. Isozyme extracts were prepared from seeds, 6-week old seedlings, and leaf tissue at flowering. The

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isozyme banding patterns for peroxidase (PER) varied among the species from a single visible band of activity to as many as 14 bands or zones of activity. Alcohol dehydrogenase (ADH) zymograms exhibited from zero to three bands of activity with most species having only a single band. However, there were notable differences in band migration among those species with a single band. Several species also exhibited intraspecific variability for this isozyme. Glutamate oxylacetate transaminase (GOT) banding patterns varied between two and three bands and one band appeared common to all species. Differences in band mobility were also evident for this isozyme. The zymogram for catalase (CAT) was visualized as a single broad smear in all species. There was, however, differential migration of this activity among the species. Species in the same taxonomic group generally had more similarities in their banding patterns than those of distantly related species. These results provide additional evidence for establishing phylogenetic relationships among the Nicotiana species, as well as, a basis for more detailed genetic analyses and mapping studies within the genus.

C. Development of Disease Resistant Germplasm.

Although potato virus Y (PVY) is currently not a serious disease problem in the flue-cured tobacco production area, it poses a potential threat especially for farmers who must utilize root knot nematode (RKN) resistant varieties. All root knot resistant cultivars are highly susceptible to PVY. Among the Nicotiana species, N. tomentosa (acc. 58) has been found to be resistant to the root knot nematode (M. incognita) and immune to infection by PVY. Efforts are continuing to introgress genes for root knot resistance from this species into flue-cured germplasm. After four backcrosses, root knot resistance remains unstable and fertility of this material is below normal. Testing and selection are continuing.

In addition to utilizing the Nicotiana species as a source of resistance to PVY, attempts are underway to develop resistance from intraspecific germplasm sources. Screening tests have identified the cigar binder tobacco cultivar Havana 307 as being most resistant. More than 250 anther-derived doubled haploids from crosses between adapted flue-cured varieties and Havana 307 have been evaluated for PVY resistance. Ten of these lines had resistance equal to the resistant parent and 68 others were tolerant to infection by PVY. These lines will be evaluated in the field for yield and quality. This later project is being carried out in cooperation with Dr. G. V. Gooding.

D. Development of Insect Resistant Germplasm.

The evaluation of over 800 anther-derived doubled haploids for tobacco budworm resistance was completed. This material represented crosses between several adapted flue-cured cultivars and 8 lines originally identified as resistant from a cross involving TI 1112, a nonglanded, primitive type tobacco. Lines with high levels of budworm resistance were identified but most of these lines have plant features similar to the primitive looking resistant parent and are agronomically unacceptable. Additional backcrosses have been made and a second cycle of evaluation and selection is being pursued.

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II. Graduate Students: none

III. Postdoctoral Fellows: none

IV. Publications:

Lax, A. R., K. C. Vaughn, V. A. Sisson, and G. E. Templeton. 1985. Ferredoxin-NADP+ reductase, a nuclearly-coded enzyme unaffected by tentoxin treatment. Photosynthesis Research 6:113-120.

Lax, A. R., K. C. Vaughn, and V. A. Sisson. 1985. Correlation of a chloroplast envelope protein with tentoxin sensitivity. Plant Physiol. 77(4):38.

Sisson, V. A. 1985. Isozyme studies of the genus Nicotiana. Agronomy Abstracts. American Society of Agronomy. Madison, WI. p. 70.

V. Manuscripts Accepted for Publication:

Snook, M. E., P. F. Mason, and V. A. Sisson. 1986. Polyphenols in the Nicotiana species. Tob. Sci. (in press).

VI. Manuscripts in Review:

VII. Papers Presented at Professional Meetings:

Arrendale, R. F., R. F. Severson, L. B. Smith, K. L. McDuffie, V. A. Sisson, and R. H. Cox. 1985. Characterization of Chemists' Research Conference. Montreal, Quebec. October 2-5. p. 13. (Abstract).

Jackson, D. M., V. A. Sisson, and R. F. Severson. 1985. Relationship between levels of cuticular components from green leaves of Nicotiana species and oviposition by tobacco hornworm moths. 39th Tobacco Chemists' Research Conference. Montreal, Quebec. October 2-5. p. 7. (Abstract).

Jackson, D. M., V. A. Sisson, and R. F. Severson. 1985. Ovipositional stimulants for Heliothis virescens moths identified from Nicotiana species. Entomological Society of America Annual Meeting. Hollywood, FL. December 8-12.

Severson, R. F., R. F. Arrendale, M. E. Snook, and V. A. Sisson. 1985. 1'-(3-hydroxy-12-methyltridecanoyl) nornicotine from the Nicotiana species, N. repanda, N. stocktonii, and N. nesophila. Annual Meeting of the Georgia Academy of Science, West Georgia College, Carrollton, GA. April 26-27.

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Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

Severson, R. F., H. G. Cutler, P. D. Cole, D. M. Jackson, V. A. Sisson, A. W. Johnson, G. A. Herzog, and M. G. Stephenson. 1985. Biologically active components in the cuticulae of the Nicotiana species. In Proceedings of the 12th Annual Meeting of the Plant Growth Regulator Society. July 28-August 1, 1985, Boulder, CO.

Severson, R. F., L. B. Smith, R. F. Arrendale, and V. A. Sisson. 1985. Green leaf cuticular chemistry of Nicotiana sylvestris and N. tomentosiformis. Annual Meeting of the Georgia Academy of Science, West Georgia College, Carrollton, GA. April 26-27.

Sisson, V. A., and R. F. Severson. 1985. Leaf chemistry of the Nicotiana species -- Hydrocarbons (C25 - C36). 39th Tobacco Chemists' Research Conference. Montreal, Quebec. October 2-5. p. 23. (Abstract).

Snook, M. E., R. F. Severson, G. R. Gwynn, and V. A. Sisson. 1985. Polyphenol levels versus tobacco leaf development. 39th Tobacco Chemists' Research Conference. Montreal, Quebec. October 2-5. p. 6. (Abstract).

Snook, M. E., P. F. Mason, and V. A. Sisson. 1985. Isolation and identification of flavanoids of Nicotiana species. Annual Meeting of the Georgia Academy of Science, West Georgia College, Carrollton, GA. April 26-27.

VIII. Graduate Student Theses Completed During Reporting Period: none

IX. Acknowledgements:

Appreciation is expressed to participants in cooperative research efforts including R. F. Severson and M. E. Snook (Chemistry), D. M. Jackson (Entomology) and G. V. Gooding (Pathology). A special thanks is extended to E. H. Brummitt and E. T. Woodlief for their excellent technical and clerical skills.

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Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

Title: NC 05524 Development and Evaluation of New Sources of Nicotiana germplasm

Project Leader(s): Sandra M. Reed

I. Summary of Research:

Karyotype Studies in N. tabacum

Tobacco (N. tabacum L.) has been investigated extensively on a cytogenetic basis; however, little work has been done in the area of developing a detailed Karyotype of the species. The lack of effort in this area has primarily been due to the small size of the N. tabacum chromosomes and their lack of distinguishing morphological characteristics. The purpose of the present study was to describe the nucleolar organizing regions (NORs) of N. tabacum, which are morphological markers that can be used to distinguish N. tabacum chromosomes.

The number of NORs in N. tabacum has been disputed, with different researchers reporting one, two or three pairs of NOR chromosomes. The number of NORs was determined in this study by analyzing associations of NORs with nucleoli in meiotic diplotene configurations. In the five cultivars included in this study, "By 21", "NC 95", "SC 58", "C 139", and "Kupchunas", all were observed to have a maximum of three bivalents associated with the nucleolus. Data from root tips of By 21 and NC 95 agree with the diplotene data, with a maximum of six satellited chromosomes being observed. Mitotic studies have not yet been completed for the other cultivars; however, there appears to be no difference between N. tabacum cultivars in terms of number of satellited, or NOR, chromosomes. Some differences in morphology of the satellited chromosomes between cultivars have been observed, but these differences have not yet been completely analyzed.

Aneuploid Collection

Transfer of the monosomic collection: The N. tabacum aneuploid collection is maintained at NCSU. Included in this collection are the 24 N. tabacum monosomics (2N-1 chromosomes) and 2 N. tabacum nullisomics (2N-2 chromosomes). The monosomics and nullisomics were originally isolated in the genetic stock "Red Russian" and have been maintained in such since the 1930's. Red Russian, which was bred as a horticultural variety, is outstanding in its complete lack of desirable characteristics. Its extreme susceptibility to disease and environmental stress make it difficult to maintain in the greenhouse and have limited the usefulness of the aneuploid collection. In an effort to make the monosomic collection

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more useful a transfer to flue-cured cultivar "SC 58" was initiated by Dr. D. U. Gerstel in the early 1970's. Several of the SC 58 monosomic lines have been advanced to the 7th or 8th backcross and are sufficiently homozygous to be characterized and used in genetic studies. Six of the SC 58 monosomics, Monosomics C, E, F, N, P and Z, were identified and characterized during the summer of 1985 at the Genetics Garden (Unit 1). These SC 58 monosomics were found to most resemble their Red Russian counterparts in flower and pollen characteristics. The plant height and leaf shape characteristics used to identify the Red Russian monosomics were of little use with the SC 58 monosomics. The characterization of the remaining SC 58 monosomics is continuing.

Production of Nullisomics: An attempt is being made to produce additional N. tabacum nullisomics. The approach that is being taken is to induce maternal haploidy in N. tabacum monosomics, with the hope that some of the 23 chromosome female gametes will be induced to develop into nullihaploid plants. Following chromosome doubling of the nullihaploids, nullisomics would be produced.

Using an irradiated pollen procedure for the induction of haploidy, a new nullisomic, Nullisomic H, has been produced. It is a small, dark green plant with many branches and small dark carmine flowers. Unlike the two tobacco nullisomics which are currently being maintained in the NCSU tobacco aneuploid collection, Nullisomic H appears to be completely sterile and can therefore be maintained only by vegetative cuttings.

Induction of Haploidy via Irradiated Pollen

Pollination of N. tabacum with N. glutinosa pollen that has received a gamma-irradiation treatment has been found to induce maternal haploidy. Pollinations of "SC 58", "Ky 17" and "Red Russian" with pollen that had received 50, 75 or 100 krad of gamma-irradiation were made. For each irradiation rate, SC 58 produced more plants than did either of the other two cutivars. The 50 krad treatment produced the most plants; however, both haploids and aneuploid hybrids were produced at this level of pollen irradiation. Most of the plants from the 75 and 100 krad irradiations were haploid. Frequently of plant production dropped sharply at these higher levels, esepcially in the KY 17 and Red Russian crosses. The frequency of haploid plant production in this irradiated pollen system is being compared to that from the N. africana system.

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II. Graduate Students:

M. G. Kramer. M.S. Production of Nullisomics of N tabacum

IV. Publications:

Reed, S.M. and R.C. Rufty. 1985. Reaction of calli of blue mold resistant and susceptible Nicotiana genotypes to infection by Peronospora tabacina. Tob. Sci. 29:53-56.

V. Manuscripts Accepted for Publication:

Reed, S.M. and J.A. Burns. 1986. Cross-restoration between Nicotiana cytoplasmic male sterile and restored lines. J. Hered.

VI. Manuscripts in Review:

Reed, S.M. and J.A. Burns. A modified Nicotiana mitotic chromosome technique. Tob. Sci.

VII. Papers Presented at Professional Meetings:

Reed, S.M. and J.A. Burns. Cross-restoration between Nicotiana cytoplasmic male sterile and restored lines. 1985. American Society of Agronomy Annual Meetings, Chicago, IL. Dec. 1-6, 1985.

Kramer, M.G. and S.M. Reed. Production of nullisomics of Nicotiana tabacum through the use of female gametes. 1985. American Society of Agronomy Annual Meetings, Chicago, IL. Dec. 1-6, 1985.

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Title: Varietal Evaluation Studies in Flue-Cured Tobacco

Project Leader: Daryl Bowman

I. Summary of Research:

A. N. C. Official Variety Test - Tobacco (1985)

Twenty-five released varieties and 31 experimental lines were tested at five locations. Included in the experimentals were 11 entries in the Regional Farm Test. NC 95 and NC 2326 were included as standards in these tests.

Up-to-date information is available on the performance of these varieties in the results of the North Carolina Official Variety Research Report No. 103, dated December 1985 from experiments conducted in 1985. The test locations represent growing conditions in the Border, Eastern, Middle and Old Belts in North Carolina. Research Report No. 103 serves as a guide in helping growers choose their 1986 varieties for planting. Copies of this report are mailed to county extension chairmen, seedsmen, and agri-business representatives.

Combined data from the 1985 trials from four locations are shown in Table 1.

B. Regional Minimum Standards Program

The first phase of the Regional Minimum Standards Program consists of the Regional Small Plot Tests which are located on tobacco experiment stations in the flue-cured region. In North Carolina the tests are located at the Border Belt Tobacco Research Station, Lower Coastal Plain Tobacco Research Station and the Oxford Tobacco Research Station.

In 1985, forty entries were included in the Regional Small Plot Test, along with the two standards--NC 2326 and NC 95. A separate publication giving individual location data and combined data for six locations has been distributed to all committee members and other interested parties. Twenty-one lines met the minimum standards in the Regional Small Plot Test and may be advanced to the Regional Farm Test in 1986.

The Regional Farm Test is the final phase of the Regional Minimum Standards Program and in 1985 contained eight lines which were evaluated under code by the Variety Evaluation Subcommittee of the Flue-Cured Tobacco Quality Committee. All eight met the minimum standards. The lines were Coker 83-379Y, Golden 141, NC TG-27, NC TG-28, NC 2060 USDA, NK 336, NK 3240, and Reams 158. These have been evaluated for two years in the Regional Small Plot Test and one year in the Regional Farm Test and have met the standards as prescribed. This makes 81 entries that have met the minimum standards since this program was developed. Seed of these eight

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lines may be available for 1987 plantings should the breeder or agency decide to increase the seed. Data from the Regional Farm Test are published annually in the Flue-Cured Tobacco Variety Evaluation Committee Report.

II. MS Graduate Student

Terry Kelley

IV. Publications

Bowman, D. T., T. Corbin, and G. Tart. "Measured Crop Performance Tobacco 1985." Research Report No. 103, December 1985.

Bowman, D. T., E. A. Wernsman, T. C. Corbin, and A. G. Tart. 1985. Performance of four Maryland tobacco cultivars under two different harvest schemes in North Carolina. Tob. Sci. 29:16-19.

Bowman, D. T., and J. O. Rawlings. 1985. An empirical method for establishing chemical standards for flue-cured tobacco. Tob. Sci. 29:47-52.

Bowman, D. T., T. C. Corbin, and A. G. Tart. 1985. Variance component estimates for several traits of flue-cured tobacco. Tob. Sci. 29:113-115.

VI. Manuscripts Released for Publication

Bowman, D. T., E. A. Wernsman, T. C. Corbin, and A. G. Tart. Stability of flue-cured tobacco cultivars for yield and quality. Tob. Sci. (In Press).

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NORTH CAROLINA OFFICIAL VARIETY TESTS
COMPARISON OF VARIETIES IN 1985 FOR CERTAIN CHARACTERISTICS
COMBINED FOR FOUR LOCATIONS: WHITEVILLE, ROCKY MOUNT, OXFORD, AND REIDSVILLE

Table 1.

Variety	Grade Index	Value Index $/Cwt.	Value Index $/A	Yield Lbs/A	Days to Flower	Leaves per Plant	Plant Height Inches	Ground Suckers	Cured Leaf Analysis Red. Sug.	Cured Leaf Analysis Tot. Alk.	Cured Leaf Analysis Sug. Alk.
NC 2326	58	184.53	5283	2865	58	17.0	42	0.7	19.49	2.89	6.96
NC 95	57	182.48	5460	2990	62	18.0	41	1.8	20.54	2.88	7.46
Clemson PD4	59	185.17	6240	3369	63	19.1	43	0.7	20.99	2.46	8.92
Clemson PD279	56	180.34	5085	2824	62	17.0	40	0.4	19.00	2.78	7.28
Coker 48	53	180.54	5837	3232	65	18.8	42	1.4	20.89	2.69	7.87
Coker 176	62	185.16	5567	3009	63	19.0	41	1.2	18.60	2.94	6.43
Coker 206	55	179.88	5584	3107	66	18.2	39	1.0	18.17	3.05	6.18
Coker 298	59	179.19	5053	2820	67	19.0	43	1.1	18.39	3.03	6.11
Coker 319	64	185.77	5437	2926	64	18.4	41	1.5	19.64	2.51	8.18
Coker 347	48	178.79	5934	3323	64	19.3	41	1.8	19.51	3.06	6.94
K 317	67	184.11	4888	2660	64	17.6	40	1.0	16.83	2.82	6.17
K 326	67	187.55	6244	3337	65	19.0	39	0.8	19.99	2.57	8.44
K 394	58	183.01	6378	3483	63	18.1	38	0.7	22.11	2.20	10.33
K 399	63	183.86	5713	3107	61	18.8	37	0.7	18.54	2.56	7.66
McNair 373	68	188.21	5701	3035	59	19.1	37	1.3	20.12	2.93	7.04
McNair 944	60	183.81	5592	3047	63	17.8	38	0.9	21.14	2.74	8.02
NC 22NF	61	185.42	5757	3104	66	19.1	41	0.4	19.64	2.61	7.97
NC 50	61	185.54	6021	3249	66	19.0	41	0.7	20.49	2.35	9.41
NC 82	64	185.48	5329	2873	61	17.9	39	2.1	21.58	2.27	9.96
NC 85	60	181.74	5191	2860	65	19.1	42	1.0	19.58	3.05	6.54
NC 567	65	185.94	5473	2946	63	18.4	43	1.4	21.09	2.91	7.82
Speight G-28	63	182.92	5670	3099	61	18.1	38	1.0	20.29	2.35	8.91
Speight G-70	60	183.78	5618	3062	62	17.7	36	2.4	21.34	2.63	8.55
Speight G-80	55	179.62	5403	3003	62	17.9	38	1.2	18.97	2.49	7.79
VA 182	65	184.94	5584	3016	63	18.8	42	1.8	19.91	2.69	7.41
Mean	60	183.51	5602	3054	63	18.4	40	1.1	19.87	2.70	7.77
BLSD (K-100)	9	5.28	441	220	4	1.6	3	0.6	3.75	0.41	1.78
C.V. (%)	13	3	7	7	5	7	6	44	13	12	21

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ANNUAL REPORT ON TOBACCO WEED CONTROL RESEARCH

March 1, 1985-February 28, 1986

Title: Project State NCO-3774, Effective and Efficient Weed Management Programs for Corn, Tobacco, Small Grains and Sorghum
and
Project State NCO-3569, Vegetation Control in No-Tillage Crop Production

Project Leader: A.D. Worsham, Professor, Crop Science Department[1]

Abstract: Two new experimental herbicides, imazaquin (Scepter) and FMC 57020 (Command), continued to give good weed control in conventional and no-till flue-cured and burley tobacco. Scepter, applied to the soil surface before transplanting or over-top immediately after transplanting, gave severe early-season stunting in locations that received rainfall or irrigation soon after application. No injury to tobacco was noted from Command, but small grain planted in the fall was moderately to severely injured. Other herbicides in preliminary evaluation which gave acceptable weed control were diethatyl (Antor), RE 39571, cinmethylin (Cinch) and chloramben (Amiben). Amiben, when applied overtop, caused injury in the form of malformed lower leaves and some stunting. The postemergence grass herbicides sethoxydim (Poast), and fluazifop butyl (Fusilade) gave good control of large crabgrass without injury to the tobacco. In burley tests, hairy galinsoga (a difficult-to-control weed) control was excellent (90+%) in 1985 with Devrinol, Amiben and Scepter. Diphenamid gave good (86 %) control. Weed control in no-till tobacco was variable. Plots with good weed control yielded well. No-till tobacco in one test on a clay soil yielded 38% less than conventional, one test on a sandy loam soil, 32% less and in another test, 20% less. No-till burley tobacco yielded as much as conventional. In a variety test in no-till flue-cured tobacco, higher yields (3015 and 3085 lb/A, respectively), were obtained with K-326 and NF-28 over C-319, NF-22, G-70 and NC-82 (averaging 2502 lb/A). Most no-till plots where registered herbicides were used had to have some hand weeding to attain acceptable weed control. The fertility test site was infested with morningglory and control was poor. All conventional tobacco out-yielded the no-till and had a higher price per lb., although grade index was not different. In the conventional and no-till tobacco, the higher rates of fertilizer tended to increase yields. This resulted in lower quality in the conventional but not in no-till. The two on farm no-till tests in flue-cured tobacco were heavily affected by drought and all no-till treatments yielded about 400 lb/A less than conventionally tilled and fertilized tobacco. In general, the no-till tobacco seemed to be more adversly affected by drought than conventionally tilled tobacco. This might have been caused by the water shedding effect of the firm, untilled soil plus the funneling of water by the raised row ridges.

[1]In cooperation with Robert L. Davis, Assoc. Ext. Prof., (Burley Tobacco). Mt. Research Station, Waynesville, N.C.,; W. David Smith, Ext. Assist. Prof. (Tobacco); R.F. Walls and Tom Wiepke, Grad. Assistants; and technical assistance from Richard Lemons, Res. Technician and Scott Kirshner, R.J. Reynolds Undergraduate Research Apprentice.

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1. Summary of Research (Tests in Group 1):

1. General Experimental Methods: Twelve types of experiments were conducted in the field in 1985. This research will be separated into two major groups. The first group (Group 1) consists of several different tests involving herbicide evaluations in conventional flue-cured tobacco and conventional burley tobacco. The second group (Group 2) consists of several experiments related to the production of no-till flue-cured tobacco and no-till burley tobacco.

The following are the subtitles given to the experiments in Group 1: (A) Herbicide Evaluation Test in Flue-cured Tobacco, (B) Surface Applied Tobacco Herbicide Evaluation, (C) Overtop Herbicide Evaluation in Tobacco, (D) Imazaquin Evaluation in Flue-Cured Tobacco, (E) Post Emergence Grass Herbicide Test in Tobacco, (F) Herbicide Evaluation Test in Burley Tobacco, and (G) Burley On-Farm Weed Control Tests.

The tests in Group 1 were conducted at the following research stations: Central Crops Research Station near Clayton, the Upper Coastal Plains Research Station near Rocky Mount, Lower Coastal Plains Tobacco Research Station near Kinston, the Upper Piedmont Research Station near Reidsville, and the Mountain Research Station near Waynesville. On-farm tests were conducted in several counties in the burley area of Western North Carolina.

Product description, including chemical names, common names and manufacturers of compounds used in 1985 are given in Table 1. Other detailed information (such as soil description, tobacco varieties, and treatment dates) is included in the narrative with each test. These narrative data tables are in the Appendix, along with weather data (Appendix Tables 1-16). A WSSA approved list of computer codes for weeds reported in this research is given in Table 2.

Herbicide treatments were applied broadcast with a CO_2 pressurized backpack sprayer having five whirl-chamber nozzles on a boom at 20-inch spacings. The sprayer was operated at 3 mph and 20 psi to deliver 19.1 gal/A. For incorporated treatments, herbicides were disked in immediately after application with a tandem disc harrow set to cut 4 to 6 inches deep and operated at 4 mph. Two lengthwise trips were made down and back in each plot with the disc. In the surface-applied treatments, all beds were first knocked off to obtain an 8 to 10-inch flat bed top and herbicides were applied broadcast before transplanting. A one-row power-driven rotary cultivator was used to incorporate treatments on top of the beds. The overtop treatments were applied to the plots immediately after transplanting. Post treatments were applied overtop to the plants three to four weeks after transplanting. After the layby cultivation, herbicides were applied using a two-nozzle boom at 19.1 GPA for a semi-directed spray. Any variations in these methods will be given in specific methods for each test.

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The tobacco was grown according to standard practices and was harvested and cured by flue-cured or burley methods. All tobacco on the research stations was irrigated as needed except at the Kinston location. An official grader rated the tobacco by plot and by priming. The average price per grade from September 1984 to September of 1985 was used in calculating the value per acre for the treatments. Some of the tests were analyzed for certain chemical constituents in the Crop Science Department tobacco chemistry laboratory.

All in-field ratings of experiment plots were made independently each time by two persons and these values were averaged to obtain a rating for a particular plot. Weed control ratings are based on a 0 to 100 scale; 0 = no control and 100 = perfect control. Injury ratings are based mainly on stunting of tobacco plants unless otherwise specified (0 = no injury, 100 = crop kill).

Rainfall data for the tobacco research locations are given in Appendix Tables 12 through 16.

A. Herbicide Evaluation Test in Flue-Cured Tobacco. The herbicides used are listed in Tables 3 and 4. A randomized complete block design with 3 replications was used at the Rocky Mount location. This test received two cultivations during the growing season.

Weed control and injury ratings were taken throughout the growing season. Weed control ratings were based on large crabgrass at < 1/sq. ft., common purslane at 1/sq. ft., redroot pigweed at < 1/sq. ft., and tall morningglory at 1/sq. ft.. Injury ratings were on percent stunting (0 = no injury and 100 = complete kill).

Results: All herbicides did an excellent job of controlling large crabgrass and common purslane (Table 3). Redroot pigweed control was excellent with imazaquin at all rates. Also, all overtop treatments of herbicides were very good to excellent in controlling redroot pigweed in early-season ratings.

With dry conditions through mid-season plus cultivations, all plots remained clean through late-season.

Early season stunting was severe with all treatments and rates of imazaquin (Table 3). An irrigation of 3 inches of water immediately after the over-the-top applications probably moved imazaquin into the root zone resulting in the severe stunting in early-, mid- and late-season ratings. Chloramben at 3.0 lbs. ai/A applied PBI and overtop caused crinkling along the outer edges, slightly strap-shaped leaves and stunting in early season. The leaf malformation was not evident in mid- and late-season, however stunting persisted into late-season and most of the lower malformed leaves remained on the plants. Even though tobacco yields, quality and chemical constituents showed no significant differences (Table 4), we feel this amount of injury from the rates and methods tested for imazaquin and chloramben would not be acceptable to growers.

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B. Surface Applied Tobacco Herbicide Evaluation. Herbicides used are listed in Table 5. A randomized complete block design with 4 replications was used at the Kinston location. This test received two cultivations during the growing season. For surface treatment, tobacco beds were knocked off so that as little soil disturbance as possible was obtained during the transplanting operation. Herbicides were applied broadcast before transplanting.

Weed control and injury ratings were taken throughout the growing season. Weed control ratings were based on large crabgrass at <1 sq. ft. and prickly sida at <1 sq. ft. Injury was based on percent stunting (0 = no stunting and 100 = complete kill).

Results: Extremely dry conditions persisted till-late season, and no irrigation was available, so tobacco was stressed. Command at .75 and 1.25 lbs. ai./A gave excellent control of large crabgrass and prickly sida. Imazaquin at .01 and .13 lbs. ai./A gave excellent control of prickly sida and fair control of large crabgrass (Table 5).

No significant injury was obtained in early or late season (Table 5). There were no significant differences in yield, price or grade index. With late rains and late harvest, the tobacco yielded better than expected (Table 5).

C. Overtop Herbicide Evaluation in Tobacco. The herbicides used are listed in Table 6. A randomized complete block design with 4 replications was used at the Kinston location. This test received two cultivations during the growing season. Weed control and injury ratings were obtained throughout the growing season. Weed control ratings were based on large crabgrass at <1 sq. ft. and prickly sida at <1 sq. ft. Injury ratings were based on percent stunting (0 = no injury and 100 = complete kill).

Results: Command at 1.0 lb ai./A gave excellent control of large crabgrass and prickly sida. All treatments gave very good to excellent early-season grass control (Table 6). Imazaquin at .09 lbs ai./A alone and in combination with RE 39571 gave excellent prickly sida control and good large crabgrass control.

Only chloramben at 3.0 lbs ai./A overtop gave significant early injury. Slight crinkling of outer leaf and a strap shape leaves were noted in early-season. By the end of the season no injury was observed with any of the treatments (Table 6).

There were no significant differences in yield, price or quality of the tobacco (Table 6).

D. Imazaquin Evaluation in Flue-Cured Tobacco. Herbicides used in this test are listed in Tables 7, 8, 9 and 10. A randomized complete block design was used at two locations, Clayton and Reidsville, with 4 and 3 replications, respectively. Both locations received two cultivations during the growing season.

Weed control and injury ratings were taken throughout the growing

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season. Weed control at Clayton was based on large crabgrass at 1/sq.ft., redroot pigweed at 1/sq. ft., and common lambsquarter at <1/sq. ft. At the Reidsville location weeds present were large crabgrass at 1-3/sq. ft., common lambsquarter at 1/sq. ft., and redroot pigweed at <1 sq. ft. Injury at both locations was based on percent stunting (0 = no injury and 100 = complete kill).

Results: At Clayton, imazaquin at .13 lbs. ai./A OT, pendimethalin at 1.0 lbs. ai./A SUR, diphenamid at 4.0 lbs. ai./A, and Command at 1.0 lbs ai./A SUR and OT gave excellent control of large crabgrass in early-season (Table 7). All treatments gave very good to excellent early-season control of common lambsquarter and redroot pigweed. By the season's end, only Command at 1.0 lbs. ai./A (both SUR and OT), pendimethalin at 1.0 lbs. ai./A SUR and pendimethalin at 1.0 lbs. ai./A in combination with imazaquin at .06, .09 and .13 lbs. ai./A LBY gave good control of large crabgrass. All treatments including imazaquin gave very good to excellent late-season control of pigweed.

Slight stunting with imazaquin was observed in early-and mid-season (Table 7). There were no significant differences in yield, price and quality of the tobacco (Table 8). At the Reidsville location, all treatments gave very good to excellent control of large crabgrass, redroot pigweed and common lambsquarters (Table 9).

All imazaquin treatments applied SUR or OT gave severe stunting through mid-season. This test site received 1.76 inches of rain within 48 hours after the overtop herbicide application. Dry conditions, however, persisted through mid-season. These two factors could account for the extreme stunting from the imazaquin treatments (Table 9).

Yield, price and quality showed no significant differences. There were no significant differences in chemical constituents at either location (Table 10).

E. Postemergence Grass Herbicide Test in Tobacco. The herbicides used in this test are listed in Table 11. A randomized complete block design with 3 replications was used at the Reidsville location. Tobacco was transplanted and left without evaluation for approximately four weeks. When the grass was 2 inches in height, all treatments were applied broadcast directly over the top of the tobacco. This test received only one cultivation during the growing season.

Weed control ratings were based on large crabgrass at 3-5/sq. ft. Injury ratings were based on percent stunting or leaf distortion.

Results: Both sethoxydim and PPOOS plus Agridex gave excellent large crabgrass control in early-season. When diphenamid at 4.0 or 6.0 lbs. ai./A was added to the sethoxydim, season long grass control was excellent. There was no significant injury throughout the gowing season (Table 11).

Yields, price and grade index showed no significant differences. There were no significant differences in chemical constituents (Table 11).

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F. Herbicide Evaluation Test in Burley Tobacco. Herbicides are listed in Table 12. A randomized complete block design with 3 replications was used at the Waynesville location. For the surface applications, treatments were applied broadcast to a prepared flat surface before transplanting. Overtop applications were made immediatedly after transplanting.

Weed control and injury ratings were based on large crabgrass at 1/sq. ft. and common lambsquarters 1-3/sq. ft. Injury ratings were based on percent stunting (0 = no stunting and 100 = complete kill). This test received two cultivations during the growing season.

Results: Command at 1.25 lbs. ai./A, both SUR and OT applied, gave excellent control of large crabgrass and common lambsquarters throughout the growing season with no significant crop injury (Table 12). Imazaquin at .09 and .13 lbs. ai./A gave very good to excellent control of large crabgrass and common lambsquarters thoughout the growing season, but the .13 lbs. ai./A rate when applied OT caused early-season stunting (Table 12). Chloramben at 4.0 lbs. ai/A SUR applied gave good grass and excellent lambsquarters control with no significant injury. Chloramben at 4.0 lbs. ai./A OT gave very good control of both large crabgrass and common lambsquarters. Both rates of Chloramben applied over-the-top significantly damaged the lower leaves of the tobacco in the early part of the season. The damage noted was expressed as crinkling of the outer edges of leaves and strap-shaped leaves. There were no significant differences in yield or price of the tobacco among treatments (Table 12).

G. Burley Tobacco On-Farm Herbicide Tests. Herbicides used are listed in Table 13. Cooperating with R.L. Davis, Burley Extension Specialist, 13 on-farm tests were put out in 10 counties in the burley-producing area in Western North Carolina. Rates used were pendimethalin (1.0 lb. ai/A PBI), napropamide (2.0 lbs. ai./A OT), diphenamid (4.0 and 6.0 lbs. ai./A), and isorporalin (1.5 lbs. ai./A PBI). At one location four extra treatments including imazaquin and chloramben were added for comparisons. Plot size was 16 feet (4 rows) by 40 feet with 3 replications. Weed control ratings were taken about 21 days after transplanting and before the first cultivation. The standard tobacco herbicides were applied as recommended.

Results: Common lambsquarters control was fair to good with all the standard herbicides with exception of diphenamid at the lower rate which gave poor control (Table 13). Both chloramben and imazaquin at both rates and methods did an excellent job in controlling common lambsquarters. Again both chloramben and imazaquin at both rates and methods controlled smooth crabgrass significantly (93 to 100%) better than all the standard herbicides (73 to 85%) (Table 13).

Hairy galinosoga control was excellent with napropamide (2.0 lbs. ai./A OT), chloramben (3.0 lbs. ai./A OT), and imazaquin (1.5 lbs. ai./A SUR and OT). Diphenamid at 4.0 and 6.0 lbs. ai./A OT gave very good control.

Common purslane control was excellent with both rates and methods for chloramben and imazaquin. Also, the standard incorporated treatments,

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pendimethalin (1.0 lb. ai./A PPI) and isopropalin (1.5 lbs. ai./A PPI), gave very good control of common purslane (Table 13).

Common ragweed control was poor with all standard treatments (35 to 40%). Pendimethalin (1.0 lb. ai./A PPI), diphenamid (6.0 lbs. ai/A OT), and isopropalin (1.5 lbs. ai/A PPI) gave excellent control of redrood pigweed.

Pennsylvania smartweed control was very good to excellent (80 to 97%) with all standard treatments (Table 12).

No significant injury was observed with the standard treatments. However, both methods of application of imazaquin (1.5 lbs. ai./A) signicantly stunted the tobacco in early-season. Chloramben did not significantly stunt the tobacco, but crinkling of the outer edges and slight strap-shaping of the young leaves were observed in early-season.

Summary of Research (Tests in Group 2):

1. General Experimental Methods: The second group of experiments were designed to evaluate several aspects of growing no-till tobacco. Included were tests to study fertilization differences in no-till vs. conventional tobacco, weed control and variety evaluation in no-till tobacco. Land was prepared, soil treatments (soil insecticide/nematicide or multi-purpose fumigant, depending on location) were applied, and land was bedded in the fall for no-till tobacco. A rye cover crop was sown and seeds were covered with a rolling cultivator adjusted to fit the beds. Approximately two weeks before transplanting, grain was killed with paraquat and in some cases a half rate of residual herbicide was mixed with the paraquat. Tobacco was transplanted using a modified commercially available no-till one-row transplanter. The transplanter was equipped with a double-disk opener, wide, rubber-tired press wheels and mounted on an articulating frame. A coulter in front of the opener was used where mulch was heavy. Tobacco was fertilized by side-dressing with 40 N - 40 P_2O_5 - 120 (K_2O) at planting and addition of 25 units of N was sidedressed later in the season. Variations in some tests are noted.

All background information is included in the narrative reports for each test (Appendix Tables 7, 8, 9, 10 and 11). Any variations in methods are given in the specific descriptions of each test.

The tests will be referred to as (H) No-Till Tobacco Herbicide Evaluation Test, (I) Fertilization Test in No-Till and Conventional Tobacco, (J) No-Till Tobacco Variety Test, (K) No-Till vs. Conventional Burley Tobacco Test and (L) No-Till On-Farm tests in Flue-Cured Tobacco. These tests were conducted at the following research stations: the Central Crops Research Station near Clayton, the Upper Piedmont Research Station near Reidsville, and the Mountain Research Station near Waynesville.

H. No-Till Flue-Cured Tobacco Herbicide Evaluation Screening Test. Herbicides used are listed in Tables 14, 15 and 16. The objectives of this test were to evaluate new herbicides and methods of application for improved weed

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control in a no-till situation. A randomized complete block design was used at two locations, Clayton and Reidsville, with 4 replications each.

Weed control and injury ratings were made through mid-season at Clayton. Weed ratings were based on common ragweed at <1/sq. ft., large crabgrass 1-3/sq. ft., redroot pigweed <1/sq. ft., and tall morningglory < 1/sq. ft. Injury ratings were based on stunting (0 = no injury and 100 = complete kill). At Clayton, by mid-season weed competition to the tobacco was so severe even in the treatments with fair control, that a decision was made to mechanically clean and harvest only certain of the better treatments. At the Reidsville location, weeds present and densities were: large crabgrass <1/sq. ft., common ragweed 1/sq. ft., carpetweed 1/sq. ft., and common lambsquarters <1/sq. ft.

Results: Rye cover kill was 100% at both locations. At Clayton, by mid-season all treatments with a total application of diphenamid (3-6 lbs. ai./A OT) and Command (1.0 lb. ai./A OT) were giving excellent control of large crabgrass (Table 14). Common ragweed and redroot pigweed control was good with Command at 1.0 lb. ai./A and imazaquin at .13 lbs. ai./A, either OT or POT. Treament No. 1 (Hoe 0661 at 1.0 lb ai./A plus diphenamid at 6.0 lbs. ai./A total) gave good control of ragweed (much better than normally would be expected) that we have no explanation for at present.

Glyphosate significantly injured tobacco at Clayton, we assume through root exudation from treated rye and uptake by the tobacco plants as has occurred in past research. There was also significant stunting with the combination of paraquat and imazaquin applied at GK1 (time of grain kill) and OT (.5 + .16 lbs. ai./A GK1 plus .06 OT) (Table 14).

Yields, quality and grade index values were not significantly different among treatments that were harvested (Table 15).

At the Reidsville location, the rye cover kill was 100% with Hoe 0661 (1.0 lbs. ai./A GK1), glyphosate (1.0 lb. ai./A GK1) and paraquat (.5 lb. ai./A GK1). Tobacco was transplanted in extremely dry conditions with very little soil moisture. Four days after transplanting and spraying, tobacco began to die, and the tobacco had to be reset. A good stand was achieved after resetting, but we feel this influenced weed ratings and especially the injury ratings. At this location, there was very little injury from imazaquin and none from use of glyphosate. These treatments caused considerable injury at the Clayton locations. Early-season large crabgrass control was fair to excellent with all treatments except paraquat at .5 lb. ia./A GK1 and paraquat at .5 lb. ai./A plus diphenamid at 3.0 lbs. ai./A GK1 which gave poor control (Table 16).

Early-season common ragweed and carpetweed control was excellent with imazaquin at .13 lbs. ai/A applied OT or BAN. Command at 1.0 lb. ai./A gave excellent control of common ragweed, but carpetweed control was poor.

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After mid-season plots were mechanically cleaned as needed so that harvest could be possible.

Slight injury with imazaquin at .13 lb. ai./A, both OT and BAN, was observed in early-season. There was no significant injury from any treatments by mid-season (Table 16).

Yields and price were significantly reduced in the treatments with poor weed control. There were no significant differences in grade index. Chemical constituents were not significantly different at this location among treatments (Table 16).

I. Fertilization Test in No-Till and Conventional Tobacco. Yields, quality, grade index, and chemical constituents are listed in Table 17.

The objective of this experiment was to determine if higher fertilization rates would increase no-till tobacco yields without adversely affecting quality. The two methods of application used were a band knifed into the soil and a broadcast surface application. Base fertilization rates after transplanting included standard (40 lb N), one-half increase in standard (60 lb N) and 2X increase in standard (80 lb N). All treatments received 25 lb N sidedressed two to three weeks after transplanting. At the Clayton location, broadcast applications of paraquat .5 and diphenamid 3.0 lbs. ai./A were applied two weeks before transplanting for grain kill and residual weed control. At transplanting, diphenamid at 3.0 lbs. ai./A OT was applied. Two days after transplanting all banded fertilizer was applied.

Results: Weed control, especially morningglory, was poor in all the no-till plots, and, therefore, influenced tobacco growth and significantly reduced yield. All conventional plots received diphenamid at 3.0 lbs. ai./A OT and three cultivations. These plots remained clean throughout the growing season. Also tall morningglory interferred with efficient harvest of the no-till plots.

All conventional tobacco significantly out-yielded and had a higher price than all no-till tobacco (Table 17). Grade index values were not significantly different among no-till treatments. The index values averaged slightly higher in the conventional tobacco as compared to the no-till. Note, in conventional tobacco the 2X band treatment increased yields, but significantly reduced grade index (quality) (Table 17). This did not occur in the no-till tobacco.

J. No-till Tobacco Variety Test. Yield, price, and grade index, and leaf chemical constituents are listed in Table 18. The objective of this test was to determine if increased yields in no-till tobacco could be obtained by using different varieties and to compare performance among several varieties under no-till conditions. A randomized complete block design was used with 8 replications at the Clayton location. Plot size was one row by 42 ft. with a final stand of 20 plants per plot. Tobacco varieties used were K-326, NF-28, C319, NF-22, G-70, and NC 82.

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The test was maintained weed free for the entire growing season by use of herbicides and hand weeding. Base fertilizer was knifed into the soil in a band with 40 lbs. of N. A band-surface sidedressing of 20 lbs. of N was applied two to three weeks after treatments.

Results: Significantly higher yields and price were obtained with K-326 and NF-28 over the four other varieties (Table 18). NF-28 had a significantly higher grade index than NF-22. Values for yield, price, and grade index were similar to the N.C.S.U. Official Variety testing results in 1985 for conventional flue-cured tobacco, and varieties in the no-till test followed a similar ranking for these parameters as varieties in the Official Variety tests. We think the significant differences in yield between varieties may be due to high root density and greater fertilizer uptake with the higher-yielding varieties. With these promising results we plan to expand our variety test in 1986.

K. No-Till vs. Conventional Burly Tobacco Herbicide Test. Herbicides used are listed in Table 19. A randomized complete block design with 4 replications was used at the Waynesville location. Paraquat at .5 lbs. ai./A was applied two weeks before transplanting, and 100 percent rye kill was obtained. Base fertilizer was broadcast at the rate of 1,000 lbs. 8-8-8/A 10 days before transplanting and 60 lbs/A N added as a surface placement about 3 weeks after transplanting.

Conventional tobacco was cultivated two times during the growing season.

Results: In early- and late-season, all treatments were giving excellent control of large crabgrass compared to the conventional and no-till checks (Table 19). Early-season common lambsquarters control was excellent with all treatments except napropamide at 1.0 lb. ai./A OT (conventional) which was giving good control. In late-season, as a whole, no-till treatments were giving significantly better control of common lambsquarters. Command at 1.0 lb. ai./A OT performed well in conventional and no-till plots. Note, compare the paraquat check in no-till to the cultivated check in conventional. The weed suppression in this no-till treatment is probably the result of allelopathic chemicals in the rye mulch, lack of soil disturbance, or both as has been the case in previous no-till tobacco research.

Imazaquin at .125 lbs. ai./A OT significantly stunted conventional tobacco in early season, but stunting was not evident in late season (Table 19).

There were no significant differences in yield or price among treatments or between no-till vs. conventional.

L. On-farm tests were conducted in Duplin and Jones Counties in 1985 (one test was lost to hail) to compare several no-till tobacco treatments with conventionally-tilled and fertilized tobacco. Results were heavily affected by drought conditions with all no-till treatments yielding approximately 400 lbs/A less than conventionally tilled and fertilized tobacco.

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Tillage and fertility treatments which included: in-row subsoiling, injected fertilizer, and surface applied fertilizer to no-till tobacco did not result in measurable differences in cured leaf yield or quality and all treatments yielded less than conventionally grown tobacco.

In general the no-till tobacco seemed to be more adversely affected by the lack of rainfall than conventionally tilled tobacco. This may be due to a water-shedding effect of the mulch and the tobacco row-ridge. Additional research is needed concerning the effects of the mulch on rainfall penetration as well as fertility and weed suppression, in-row subsoiling of no-till tobacco, and better weed control methods. A graduate student has now joined the project and work on some of the needs listed will be increased.

II. Graduate Students:

A. R.F. Walls (Co-Chairman), "The Potential of Imazaquin for Weed Control in Tobacco."

B. Tom Wiepke, "No-till Tobacco: Effect of Mulch on Herbicide Retention and Allelopathic Chemicals in Soil Under Mulch and Evaluation of Cover Crops."

C. Scott Kirshner, R.J. Reynolds Undergraduate Apprentice, "Weed Management Practices in Conventional and No-till Tobacco."

III. Postdoctoral Fellows: None

IV. Publications:

Worsham, A.D. 1985. No-till tobacco (Nicotiana tabacum) and peanuts (Arachis Iypogaea). Page 101-126 in Allen F. Wiese, ed. Weed Control in Limited-Tillage Systems. Weed Sci. Soc. Am. Monogr. Ser. No. 2, Weed Sci. Sci. Soc. Am., Champaign, IL.

Walls, R.F., W.K. Collins, A.D. Worsham, F.T. Corbin and J.R. Bradley, 1985. Research results with imazaquin on flue-cured tobacco in North Carolina. Proc. South. Weed Sci. Soc. 38:94.

Worsham, A.D., D.G. Shilling, and R.A. Liebl. 1985. The allelopathic action of mulch by wheat and rye on certain broadleaf weeds. Abstr. No. 100, 190th Ann. Meeting, Amer. Chem. Soc., Chicago, IL. Sept. 8-13, 1985.

Walls, F.R., F.T. Corbin, W.K. Collins, A.D. Worsham, J.R. Bradley and E.M. Lignowski. 1986. Absorption, translocation and metablolism of imazaquin in flue-cured tobacco (Nicotiana tabacum). South. Weed Sci. Soc. 39: (In Press).

V. Manuscripts Accepted for Publication:

Shilling, D.G., A.D. Worsham, and D.A. Danehower. 1986. The effects of mulch, tillage, and herbicides on weed control, yield and quality in flue-cured tobacco (Nicotiana tabacum L.). Weed Science.

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Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

Shilling, D.G., L.A. Jones, A.D. Worsham, R.F. Wilson, and C. Parker. 1986. The suppression of certain weed species by rye (Secale cereale L.) mulch and isolation, characterization and identification of water-soluble phytotoxins from rye. Jour. Agric. and Food Chemistry.

VI. Manuscripts in Review:

Whatley, L. and A.D. Worsham. Ragweed interference in flue-cured tobacco. Weed Science.

Wood, Sandra D. and A.D. Worsham. Reduction of soil erosion through no-tillage transplanting of tobacco. Jour. Soil and Water Conserv.

VIII. Graduate Student Theses Completed During the Reporting Period:

Walls, F.R. Weed control in tobacco with imazaquin and uptake, translocation and metabolism in tobacco.

IX. Acknowledgements:

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TABLE 1. HERBICIDES USED IN 1985

COMPANY	COMMON NAME OR DESIGNATION	TRADE NAME OR OTHER DESIGNATION	FORMULATION	CHEMICAL
AMERICAN CYANAMID	IMAZAQUIN	SCEPTER	1.5 lb/gal E	2-(4-isopropyl-4-methyl-5-oxo-2-immidazolin-2-yl)-3-quinolinecarboxylic acid
AMERICAN CYANAMID	PENDIMETHALIN	PROWL EC	4 lb/gal E	N-1-(ethylpropyl)-3,4-dimethyl-2, 6-dinitrobenzenamine
BASF	SETHOXYDIM	POAST	1.53 lb/gal EC	2-[1(ethoxyamino)-butyl 1]-5-[2-(ethylthio)-propyl]--3-hydroxy-2-cyclohexene-1-one
CHEVRON	RE 39571		3EC	5,6-dideoxy-1,2-O-(1-methylethyldene)-3-O-(2-methyl-phenyl-methyl)-2-D-glucofuranose
CHEVRON		X77	NA	Surfactant
CHEVRON	PARAQUAT	PARAQUAT CL	2 lb/gal	1, 1-dimethyl-4,4-bipyridinium ion
ELANCO	ISOPROPALIN	PAARLAN	6.0 lbs/gal EC	2,6-Dinitro-N-N-dipropylcumidine
FMC	FMC57020*	COMMAND	4 lb /gal EC	2-(2-Chlorophenyl)methyl-4, 4-dimethyl-3-isoxazol--idinone
HELENA		AGRIDEX	NA	Crop-oil concentrate
ICI	PP005	FUSILADE 2000	1 lb/gal E	(+)-butyl 2-[4-((5-(trifluoromethyl)-2-pyridinyl) oxy)phenoxy]propanoate
ICI	FLUAZIFOPBUTYL	FUSILADE	4 lb/gal E	butyl 2-[4-(5(trifluoromethyl-2-pyridyloxy))phenoxy] propanoate
MONSANTO	GLYPHOSATE	ROUNDUP	4 lb/gal E	isopropylamine salt of N-(phosphonomethyl)glycine
NOR AM	DIETHATYL ETHYL	ANTOR	4 lb/gal EC	N-chloroacetyl-N(2,6-diethylphenyl)glycine ethyl ester
NOR AM	DIPHENIMID	ENIDE	90W	N,N-dimethyl-2,2-diphenylacetamide
ROHM and HASS	OXYFLUORFEN	GOAL	1.6 EC	z-chloro-1-(3-ethoxy-4-niteophenoxy)-4-(trifluoro-methyl)benzene
STAUFFER	NAPROPAMIDE	DEVRINOL	50W	2-(a-napthoxy)-N,N-diethylpropionamide
SHELL	CINMETHYLIN	CINCH	7 lb/gal EC	[exh-1-methyl-4-(methylethyl)-2-[(2-methylphenyl) methoxyl]-7-oxabicyclo]2.2.1]heptane]
AMERICAN HOECHST	GLUFOSINATE	IGNITE	1.67 lb/gal	Ammonium (3-amino-3-carboxypropyl)-methylphosphinate
UNION CARBIDE	CHLORAMBEN	AMIBEN	75 DS	3-amino-2,5-dichlorobenzoic acid

*The proposed common names of dimethazone and penoxan were not accepted by the International Standards Organization.

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Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

TABLE 2. WSSA-Approved Computer Code Abbreviations for Weeds* and Other Abbreviations Used in Reporting 1985 Research.

Weeds Reported in 1985 Research

ABBREVIATION*	WEED SPECIES
AMARE	REDROOT PIGWEED
AMBEL	COMMON RAGWEED
CHEAL	COMMON LAMBSQUARTERS
DIGIS	SMOOTH CRABGRASS
DIGSA	LARGE CRABGRASS
GASCI	HAIRY GALINSOGA
MOLVE	CARPETWEED
PHBPU	TALL MORNINGGLORY
POLPY	PENN. SMARTWEED
POROL	COMMON PURSLANE
SIDSP	PRICKLY SIDA

Other Abbreviations used for Methods of Application

PBI	Prebed soil incorporated
PPI	Pretransplant soil incorporated
SUR	Surface applied before transplanting
OT	Over-top tobacco immediately after transplanting
LBY	Semi-directed soil surface treatment after last cultivation
POT	Postemergence over-top tobacco 2 to 3 weeks after transplanting
POD	Applied as a semi-directed postemergence treatment
BAN	Applied over-top tobacco in an 18 inch band immediatedly after transplanting
GKl	Application of herbicide to kill grain about 2 weeks before transplanting

*from Composite List of Weeds, Weed Science 32, Suppl. 2.

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Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

Table 3. Herbicide Evaluation in Flue-Cured Tobacco, Rocky Mount, N.C. 1985. Weed Control and Crop Injury.

TRT. NO.	HERBICIDE	RATE LB/A	APPLICATION METHOD**	% WEED CONTROL AND CROP INJURY DIGSA 5-13	POROL 5-13	PHBPW 5-13	AMARE 5-13	Injury 5-13	Injury 6-14	DIGSA 8-12	AMARE 8-12	POROL 8-12	Injury 8-12
1	RE 39571	1.00	PBI	90	76	50	73	4	0	93	98	93	10
2	RE 39571 SCEPTER	1.00 0.09	PBI OT	99	99	65	96	10	23	97	99	99	7
3	RE 39571	0.50	OT	88	95	33	83	2	0	96	96	98	0
4	RE 39571	1.00	OT	96	99	87	91	3	0	96	95	93	3
5	RE 39571	1.50	OT	99	99	47	63	3	0	95	99	89	0
6	RE 39571 + SCEPTER	0.50 0.09	OT OT	99	97	83	99	15	18	89	99	99	10
7	RE 39571 + SCEPTER	1.00 0.09	OT OT	96	99	87	99	30	32	68	99	99	18
8	RE 39571 + SCEPTER	1.50 0.09	OT OT	99	99	73	99	15	23	98	99	99	0
9	SCEPTER	0.09	OT	98	99	79	99	28	27	83	99	98	32
10	PROWL EC	1.00	PBI	98	99	73	93	3	5	99	99	99	5
11	PAARLAN	1.50	PBI	99	92	67	80	3	0	99	98	93	5
12	DEVRINOL	1.00	OT	99	99	60	96	2	0	91	99	94	2
13	ENIDE	4.00	OT	99	93	10	94	0	0	98	88	96	2
14	CINCH	1.00	OT	89	76	23	94	2	0	88	83	81	3
15	AMIBEN	3.00	PBI	99	99	43	99	10	13	95	99	96	10
16	AMIBEN	3.00	OT	99	99	68	99	13	22	97	99	98	10
17	AMIBEN	3.00	LBY	69	67	47	37	2	2	82	91	94	3
18	ANTOR	2.00	OT	99	96	93	93	2	3	99	99	98	3
19	ANTOR	4.00	OT	99	99	60	83	8	15	98	99	98	7
20	PROWL EC ENIDE	1.00 4.00	PBI LBY	99	99	67	87	5	0	98	98	98	0
21	ENIDE ENIDE	4.00 2.00	OT LBY	99	99	62	99	3	0	98	99	89	7
22	CINCH SCEPTER	1.00 0.09	PBI OT	99	99	81	99	18	28	98	99	99	5
23	CINCH	1.00	PBI	99	99	47	89	0	2	99	99	99	3
24	COMMAND*	1.00	PBI	99	99	72	58	0	0	98	99	99	3
25	COMMAND*	1.00	OT	96	98	70	99	3	0	96	99	99	2
26	Cult. Check	-	-	90	63	27	66	0	0	40	40	53	2
			LSD .05	16	NS	75	34	16	11	18	17	16	15
			% CV	8	16	49	20	49	92	12	11	9	129

*Wheat planted in fall after tobacco harvest was severely injured as of February 1, 1986.
There was considerable yellowing and stand loss. No wheat injury was evident from any other herbicide treatments.

**See Table 2 for explaination of abbreviations.

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Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

Table 4. Herbicide Evaluation in Flue-cured tobacco, Rocky Mount, N.C. 1985. Yield, Value and Quality.

TRT. NO.	HERBICIDE	RATE LB/A	APPLICATION METHOD	YIELD, VALUE AND QUALITY #/A	$/A	$/CWT	G. INDEX	%SUGAR	%TA
1	RE 39571	1.00	PBI	3689	6324	171.46	48	20.7	2.87
2	RE 39571 SCEPTER	1.00 0.09	PBI OT	3536	6138	173.66	48	19.1	2.97
3	RE 39571	0.50	OT	3899	6730	172.57	49	20.5	3.12
4	RE 39571	1.00	OT	3294	5656	171.75	46	20.6	3.07
5	RE 39571	1.50	OT	3693	6462	174.99	53	21.4	2.73
6	RE 39571+ SCEPTER	0.50 0.09	OT OT	3303	5646	170.54	46	19.6	2.71
7	RE 39571+ SCEPTER	1.00 .09	OT OT	3386	5819	172.83	47	20.3	3.25
8	RE 39571+ SCEPTER	1.50 0.09	OT OT	3747	6579	175.60	50	22.0	2.79
9	SCEPTER	0.09	OT	3306	5751	174.07	51	18.3	3.19
10	PROWL EC	1.00	PBI	3735	6524	174.59	51	23.4	2.98
11	PAARLAN	1.50	PBI	3692	6307	170.38	47	21.1	2.78
12	DEVRINOL	1.00	OT	3358	5771	171.21	49	22.4	2.68
13	ENIDE	4.00	OT	3525	6029	171.24	48	21.7	2.69
14	CINCH	1.00	OT	3453	5955	172.69	50	22.0	2.85
15	AMIBEN	3.00	PBI	3629	6236	171.54	46	19.4	3.21
16	AMIBEN	3.00	OT	3405	5927	174.08	49	20.5	3.05
17	AMIBEN	3.00	LBY	3183	5435	170.52	49	23.5	2.52
18	ANTOR	2.00	OT	3336	5621	168.46	48	22.4	2.71
19	ANTOR	4.00	OT	3611	6246	173.00	49	23.6	2.61
20	PROWL EC ENIDE	1.00 4.00	PBI LBY	3605	6378	176.90	53	23.5	2.78
21	ENIDE ENIDE	4.00 2.00	OT LBY	3218	5549	172.85	51	20.7	2.91
22	CINCH SCEPTER	1.00 0.09	PBI OT	3739	6411	171.46	46	20.7	2.28
23	CINCH	1.00	PBI	3403	5927	174.08	54	23.1	2.86
24	COMMAND	1.00	PBI	3796	6565	172.99	51	23.1	2.77
25	COMMAND	1.00	OT	3551	6106	172.34	48	22.5	2.74
26	CHECK CULT	0.00		3295	5603	170.00	48	21.7	2.51
	LSD .05			NS	NS	NS	NS	NS	NS
	%CV			11	11	2	8	13	17

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Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

TABLE 5. Surface Applied Tobacco Herbicide Evaluation, Kinston, N.C., 1985.

Treatment	Rate lb. ai/A	Appl. Method**	Weed Control and Injury SIDSP 5-23	DIGSA 5-23	INJURY 5-23	INJURY 6-12	DIGSA 9-12	INJURY 9-12	Yield and Quality #/A	$/A	$/CWT	Grade Index
1 Scepter	.09	Sur	95	61	0	5	75	0	2300	3708	160.89	39
2 Scepter	.13	Sur	97	77	4	8	83	0	2337	3948	162.59	39
3 Prowl EC + Scepter	1.00 0.09	Sur Sur	93	86	0	5	98	0	2368	3899	164.53	44
4 Prowl + Scepter	1.00 0.13	Sur Sur	96	84	0	8	98	0	2315	3707	161.25	41
5 Command*	0.75	Sur	93	97	1	3	95	0	2438	3935	161.59	41
6 Command*	1.25	Sur	96	98	0	1	98	0	2239	3519	157.01	39
7 Goal	.25	Sur	74	78	0	7	80	0	2419	3945	163.08	41
8 Goal	.30	Sur	79	80	0	5	85	0	2296	3714	161.05	42
9 Amiben	3.00	Sur	85	81	0	15	80	0	2300	3690	166.53	41
10 Amiben	4.00	Sur	90	98	0	3	85	0	2305	3724	161.58	42
11 Prowl EC	1.00	Sur	80	96	0	4	90	0	2301	3704	160.80	40
12 Prowl EC	1.50	Sur	80	93	0	1	90	0	2211	3476	157.18	42
13 Cinch	1.00	Sur	74	97	3	5	85	0	2384	3895	163.37	41
14 Cinch	2.00	Sur	73	94	0	1	83	0	2211	3559	160.64	41
15 RE 39571	1.00	Sur	76	91	0	5	85	0	2446	3984	160.64	41
16 RE 39571	2.00	Sur	73	78	1	6	88	0	2193	3460	157.74	41
17 Enide	6.00	Sur	78	93	5	5	90	0	2347	3836	163.52	42
18 Check Cult.	0.00	-	0	0	3	5	65	0	2249	3649	162.44	43
LSD .05			14	14	NS	7	32	-	NS	NS	NS	NS
% CV			14	14	362	82	62	-	7	9	2.36	9

*Wheat planted in fall after tobacco harvest showed moderate yellowing in all plots as of February 1, 1986. No injury to wheat was evident from any other herbicide treatments.

**See Table 2 for explantion of abbreviation.

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Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

TABLE 6. Overtop Herbicide Evaluation in Tobacco, Kinston, N.C., 1985.

Treatment	Rate Lb. AI/A	Appl. Method**	% Weed Control and Injury** SIDSP 5-25	DIGSA 5-25	INJURY 5-25	INJURY 6-12	DIGSA 9-12	INJURY 9-12	Yield and Quality #A	$/A	$/CWT	Grade Index
1 RE 39571	.50	OT	71	78	0	2	80	0	2372	3908	164.70	48
2 RE 39571	1.00	OT	70	84	1	5	85	0	2298	3844	168.44	50
3 RE 39571	1.5	OT	69	85	0	5	85	0	2290	3789	165.22	50
4 RE 39571+ Scepter	.05 .09	OT OT	93	86	0	3	88	0	2408	4037	167.46	51
5 RE 39571+ Scepter	1.00 .09	OT OT	90	87	0	3	90	0	2287	3813	166.78	49
6 RE 39571+ Scepter	1.50 .09	OT OT	96	90	1	3	95	0	2451	4105	167.46	49
7 Scepter	.09	OT	92	80	1	8	79	0	2362	3966	167.98	51
8 Devrinol	1.0	OT	71	69	0	1	82	0	2410	4001	166.01	46
9 Enide	4.0	OT	81	91	1	5	85	0	2299	3781	164.54	47
10 Cinch	1.00	OT	79	94	0	7	80	0	2308	3808	164.94	49
11 Amiben	3.00	OT	86	91	10	11	80	0	2454	4102	167.15	51
12 Amiben	3.00	LBY	60	64	1	3	85	0	2275	3754	165.02	46
13 Antor	2.00	OT	69	89	1	8	75	0	2308	3754	165.60	50
14 Antor	4.00	OT	78	94	5	9	85	0	2338	3898	166.71	50
15 Enide Enide	4.00 2.00	OT LBY	81	90	1	3	98	0	2297	3908	169.99	51
16 Check Cult	.00		21	13	1	3	65	0	2401	3958	164.95	52
17 Command*	1.00	OT	95	95	0	7	90	0	2296	3846	167.58	51
LSD .05			21	15	4	4	45	-	NS	NS	NS	NS
% CV			19	14	194	72			6	7	1.99	7

*No injury to wheat planted in the fall was seen with this or any other treatments.

**See Table 2 for explantion of abbreviations.

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Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

TABLE 7. Scepter Evaluation in Flue-cured Tobacco, Clayton, N.C., 1985.

TRT NO.	HERBICIDE	RATE LB/A	APPL'N METHOD**	% Weed Control and Injury** DIGSA 5-28	AMARE 5-28	CHEAL 5-28	INJURY 5-28	INJURY 6-14	DISGA 7-2	INJURY 7-2	DIGSA 9-14	AMARE 9-14
1	Scepter	0.06	Sur	92	92	82	1	0	73	3	48	92
2	Scepter	0.09	Sur	82	93	96	5	6	81	6	33	98
3	Scepter	0.13	Sur	89	96	96	3	6	76	5	45	95
4	Scepter	0.06	OT	80	99	95	5	5	73	5	35	92
5	Scepter	0.09	OT	71	99	96	3	3	50	8	18	98
6	Scepter	0.13	OT	93	99	99	6	10	81	9	35	92
7	Prowl EC Scepter	1.00 0.06	Sur Lby	98	98	94	0	0	98	1	93	97
8	Prowl EC Scepter	1.00 0.09	Sur Lby	96	94	95	0	1	98	0	93	95
9	Prowl EC Scepter	1.00 0.13	Sur Lby	96	99	96	1	3	97	3	90	99
10	Scepter+ Enide	0.09 3.00	OT OT	99	94	94	2	3	66	5	39	84
11	Scepter+ Prowl EC	0.13 0.75	Sur Sur	96	99	98	3	1	98	1	76	96
12	Prowl EC	1.00	Sur	84	91	82	1	1	99	1	84	84
13	Enide	4.00	OT	98	98	91	0	3	70	4	49	62
14	Command*	1.00	OT	99	91	95	1	1	95	0	86	73
15	Command*	1.00	Sur	99	91	95	1	0	99	0	87	79
16	Check Cult	0.00		23	10	15	0	3	63	1	8	20
		LSD .05		18	9.9	13	5	7	25	NS	24	26
		% CV		15	9	12	136	136	20	141	31	22

*Wheat planted in fall after tobacco harvest showed moderate yellowing as of February 1, 1986. No injury was seen from any other treatments.

**See Table 2 for explanation of abbreviations.

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Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

TABLE 8. Scepter Evaluation in Flue-Cured Tobacco, Clayton, N.C., 1985.

TRT NO.	HERBICIDE	RATE LB Ai/A	APPL'N METHOD**	YIELD AND QUANTITY LBS/A	$/A	$/CWT	GRADE INDEX	% SUGAR	% TA (Hy)
1	Scepter	0.06	Sur	3426	6417	187.46	70.68	22.2	2.79
2	Scepter	0.09	Sur	3292	6003	182.03	64.78	21.4	3.00
3	Scepter	0.13	Sur	3181	5796	181.73	63.48	22.1	2.60
4	Scepter	0.06	OT	3088	5600	179.45	60.05	21.2	2.87
5	Scepter	0.09	OT	3186	5832	182.73	67.33	24.4	2.43
6	Scepter	0.13	OT	3276	6036	184.30	66.57	19.7	3.04
7	Prowl EC Scepter	1.00 0.06	Sur Lby	3119	5658	181.20	65.87	22.2	2.69
8	Prowl EC Scepter	1.00 0.09	Sur Lby	3421	6273	183.19	63.13	22.7	2.84
9	Prowl EC Scepter	1.00 0.13	Sur Lby	3263	5971	182.95	67.83	21.9	2.92
10	Scepter+ Enide	0.09 3.00	OT OT	3323	6082	182.43	66.08	21.4	2.86
11	Scepter+ Prowl EC	0.13 0.75	Sur Sur	3260	5819	178.61	59.68	20.8	2.82
12	Prowl EC	1.00	Sur	3458	6345	183.55	69.30	23.0	2.66
13	Enide	4.00	OT	3357	6142	182.88	70.65	23.0	2.75
14	Command	1.00	OT	3440	6267	182.08	68.35	22.7	2.74
15	Command	1.00	Sur	3317	6053	182.38	67.53	23.7	2.78
16	Check Cult	0.00		3328	6077	182.55	65.80	22.3	2.78
			LSD .05	NS	NS	NS	NS	NS	NS
			% CV	10	11	2.32	8	13	14

*See Table 2 for explanation of abbreviation.

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Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

TABLE 9. Scepter Evaluation in Flue-cured Tobacco, Reidsville, N.C., 1985.

TRT NO.	HERBICIDE	RATE LB AI/A	METHOD**	% Weed Control and Injury** DIGSA 6-13	CHEAL 6-13	AMARE 6-13	INJURY 6-13	DIGSA 7-18	AMARE 7-18	INJURY 7-18	DIGSA 9-9	AMARE 9-9
1	Scepter	0.06	Sur	73	86	86	23	87	99	27	47	96
2	Scepter	0.09	Sur	87	98	98	25	90	99	28	77	99
3	Scepter	0.13	Sur	84	96	99	23	95	99	32	82	97
4	Scepter	0.06	OT	90	99	99	40	90	99	37	57	99
5	Scepter	0.09	OT	99	99	99	60	93	97	50	62	99
6	Scepter	0.13	OT	93	99	98	50	96	99	53	50	96
7	Prowl EC Scepter	1.00 0.06	Sur Lby	88	99	96	2	99	99	0	92	96
8	Prowl EC Scepter	1.00 0.09	Sur Lby	84	86	91	8	99	99	0	68	96
9	Prowl EC Scepter	1.00 0.13	Sur Lby	96	99	99	7	99	99	3	93	98
10	Scepter+ Enide	0.09 3.00	OT OT	85	99	99	38	95	99	37	73	97
11	Scepter+ Prowl EC	0.13 0.75	Sur Sur	86	94	91	27	88	98	23	82	98
12	Prowl EC	1.00	Sur	83	94	94	2	96	98	3	78	95
13	Enide	4.00	OT	97	96	96	2	88	99	3	67	97
14	Command*	1.00	OT	99	99	99	0	99	99	0	89	99
15	Command*	1.00	Sur	96	99	99	3	95	91	3	94	89
16	Check Cult	0.00		0	13	13	0	53	48	2	13	45
		LSD .05		15	12	12	19	7	3	15	46	20
		% CV		12	9	9	61	5	2	51	33	12

*Wheat planted in fall after tobacco harvest showed moderate yellowing as of February 1, 1986.

**See Table 2 for explanation of abbreviations.

2000270255

Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

TABLE 10. Scepter Evaluation in Flue-Cured Tobacco, Reidsville, N.C., 1985.

TRT NO.	HERBICIDE	RATE LB AI/A	APPL'N METHOD*	Yield and Quality #/A	$/A	$/CWT	GRADE INDEX	% SUGAR	% TA
1	Scepter	0.06	Sur	2253	3931	170.00	48	18.5	2.53
2	Scepter	0.09	Sur	2209	3702	166.91	51	19.2	2.67
3	Scepter	0.13	Sur	2283	3956	173.93	54	17.9	2.85
4	Scepter	0.06	OT	2139	3600	175.46	53	18.5	2.70
5	Scepter	0.09	OT	1973	3361	170.25	55	15.6	2.90
6	Scepter	0.13	OT	2408	4118	170.99	48	18.4	3.01
7	Prowl EC Scepter	1.00 0.06	Sur Lby	2361	4041	171.01	53	19.9	2.68
8	Prowl EC Scepter	1.00 0.09	Sur Lby	2280	3925	171.96	52	18.7	2.50
9	Prowl EC Scepter	1.00 0.13	Sur Lby	2490	4238	170.14	48	19.2	2.68
10	Scepter+ Enide	0.09 3.00	OT OT	2371	4140	174.80	56	20.9	2.75
11	Scepter+ Prowl EC	0.13 0.75	Sur Sur	2422	4205	173.58	54	18.3	2.72
12	Prowl EC	1.00	Sur	2396	4027	168.03	44	20.2	2.66
13	Enide	4.00	OT	2496	4242	169.91	48	20.9	2.68
14	Command	1.00	OT	2445	4195	171.56	53	21.0	2.65
15	Command	1.00	Sur	2354	4046	172.03	51	18.9	2.75
16	Check Cult	0.00		2203	3786	171.66	49	17.4	2.75
			LSD .05	NS	NS	NS	NS	NS	NS
			% CV	13	13	3.67	10	14	12

*See Table 2 for explanation of abbreviations.

20002702S6

Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

TABLE 11. Postemergence Herbicide Test In Tobacco, Reidsville, N.C., 1985.

TR NO	HERBICIDE	RATE LBS. AI/A	METHOD APPL.*	% Weed Control and Injury: DIGSA 6/13/85	DIGSA 9/25/85	INJURY 6/13/85	INJURY 9/25/85	Yield and Quality: #/A	$/A	$/CWT	GRADE INDEX	% SUGAR	% TA
1	Poast plus Agridex	.20 1 qt.	Pot	93	41	0	0	2199	3753	170.01	48	19.7	2.52
2	Enide plus Poast plus Agridex	4.0 .20 1 qt.	Pot	99	89	0	0	2355	3984	169.09	48	20.5	2.46
3	Enide plus Poast plus Agridex	6.0 .20 1 qt.	Pot	98	91	3	0	2589	4402	170.07	46	19.2	2.59
4	Fusilade 2000 plus Agridex	.25 1 qt.	Pot	98	0	4	0	2285	3880	169.92	47	19.9	2.42
5	Enide	6.0	Pot	13	55	0	0	2499	4295	171.74	48	21.3	2.48
6	Cult Check	-	-	0	0	0	0	2147	3672	170.86	49	20.6	2.20
		LSD..05		14	7	NS	-	NS	NS	NS	NS	NS	NS
		% CV		15	22	99	-	14	14	1.34	13	11	12

*See Table 2 for explanation of injury.

20002702S7

Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

TABLE 12. Burley Tobacco Herbicide Evaluation Test, Waynesville, N.C., 1985.

TR. NO.	TREATMENT	RATE LBS. AI/A	METHOD APPL.**	% Weed Control and Injury DIGSA 6-13	CHEAL 6-13	INJURY 6-13	DIGSA 7-15	CHEAL 7-15	INJURY 7-15	DIGSA 8-5	INJURY 8-5	Yield Value and Price LBS/A	$/A	$/CWT
1	Scepter	.09	Sur	72	83	0	97	99	0	96	0	2978	4315	145.34
2	Scepter	.13	Sur	67	87	0	98	95	3	93	0	2824	4121	145.60
3	Scepter	.09	OT	90	92	3	99	99	0	97	0	2772	3960	142.92
4	Scepter	.13	OT	89	92	17	89	89	7	87	7	2885	4248	147.22
5	Command*	1.25	Sur	95	97	0	99	99	5	97	3	2907	4195	144.25
6	Command*	1.25	OT	97	98	0	99	99	0	97	0	2544	3678	144.65
7	Amiben	2.0	Sur	60	83	0	80	85	2	78	0	2594	3706	142.81
8	Amiben	4.0	Sur	82	92	13***	89	90	13	82	10	2865	4178	145.56
9	Amiben	2.0	OT	75	87	12***	53	57	2	52	0	2846	3993	140.29
10	Amiben	4.0	OT	88	92	30***	96	90	3	93	3	2626	3863	146.91
11	Scepter	.13	LBY	13	20	0	7	20	0	13	0	2936	4427	150.65
12	Cult Check	-	-	0	0	0	0	0	0	0	0	2549	3653	143.21
			LSD .05	21	17	12	20	25	NS	21	NS	NS	NS	NS
			% CV	19	15	133	17	21	230	18	296	10	11	2.95

*Rye planted in fall after tobacco harvest showed severe yellowing and about 50% loss of stand as of February 1, 1986.

**See Table 2 foe explanation of abbreviations.

***See text for description of injury.

2000270258

Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

TABLE 13. Burley Tobacco On Farm Herbicide Test, 1985

TREATMENTS	RATE LB Ai/A	METHOD APPL.*	CHEAL 9 locations	DIGIS 8 locations	AMARE 5 locations	GASCI 6 locations	POROL 5 locations	AMBEL 2 locations	POLPY 2 locations	AVE. % INJURY 9 locations
Prowl	1.0	PPI	83	85	89	67	95	39	80	0
Enide	4.0	OT	68	79	77	87	76	35	91	0
Enide	6.0	OT	75	73	83	86	85	40	90	0
Devrinol	2.0	OT	85	74	69	92	76	40	91	0
Paarlan	1.5	PPI	76	82	85	62	90	35	97	0
		LSD .05	15	NS	11	13	13	NS	12	-
		% CV	26	24	18	22	19	47	11	-
			1 location	1 location		1 location	1 location			
Amiben	3.0	Sur	100	93		53	100			10
Amiben	3.0	OT	100	100		95	100			12
Scepter	1.5	Sur	99	97		99	99			50
Scepter	1.5	OT	100	97		98	100			28
Untreated Check	-	-	0	0		0	0			0
		LSD .15	28	15		35	28			28
		% CV	2	11		31	2			2.8

*See Table 2 for explanation of abbreviations.

2000270259

Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

TABLE 14. Herbicide Evaluation Test in No-Till Tobacco, Clayton, N.C., 1985

TRT NO.	HERBICIDE	RATE LB AI/A	APPL. METHOD***	% Weed Control and Injury*** AMBEL 5-12	DIGSA 5-29	AMARE 5-29	AMBEL 5-29	PHBPU 5-29	DIGSA 6-14	AMBEL 6-14	AMARE 6-14	INJURY 6-14
1	HOE 0661+	1.00	GKl	99	99	99	89	36	94	84	88	3
	ENIDE	3.00	GKl									
	ENIDE	3.00	OT									
2	ROUNDUP+	1.00	GKl	98	92	97	65	62	99	45	68	40
	ENIDE	3.00	GKl									
	ENIDE	3.00	OT									
3	PARAQUAT+	0.50	GKl	96	99	99	79	71	95	53	84	1
	ENIDE	3.00	GKl									
	ENIDE	3.00	OT									
4	PARAQUAT+	0.50	GKl	99	99	99	98	40	98	86	88	1
	COMMAND*	0.50	GKl									
	COMMAND*	0.50	OT									
5	PARAQUAT+	0.50	GKl	98	99	99	97	82	77	91	94	30
	SCEPTER	0.06	GKl									
	SCEPTER	0.06	OT									
6	PARAQUAT+	0.50	GKl	98	98	97	85	60	77	71	69	18
	ENIDE	6.00	GKl									
	SCEPTER	0.13	BAN									
7	PARAQUAT	0.50	GKl	97	81	83	70	27	64	96	54	21
	SCEPTER**	0.13	POT									
	PP 005	0.25	POT									
8	PARAQUAT	0.50	GKl	94	98	97	72	42	98	92	89	13
	ENIDE	3.00	GKl									
	SCEPTER**	0.13	POT									
	PP 005	0.25	POT									
9	PARAQUAT CHECK	0.50	GKl	97	40	40	30	23	35	35	36	6
	LSD .05			7	26	26	33	NS	27	44	4	15
	% CV			6	19	19	32	69	21	40	30	69

*Wheat not planted after tobacco harvest.

**Sequential application.

***See Table 2 for explanation of abbreviations.

2000270260

Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

TABLE 15. Herbicide Evaluation in No-Till Tobacco, Clayton, N.C., 1985.

TRT. NO.	HERBICIDE	RATE LB AI/A	APPL. METHOD*	YIELD AND QUALITY LBS/A	$/A	$/CWT	GRADE INDEX
1	HOE 0661+	1.00	GK1	1345	2364	170.83	65.55
	ENIDE	3.00	GK1				
	ENIDE	3.00	OT				
2	ROUNDUP+	1.00	GK1	1604	2935	182.68	67.75
	ENIDE	3.00	GK1				
	ENIDE						
3	PARAQUAT+	0.50	GK1	1826	3346	182.79	70.43
	ENIDE	3.00	GK1				
	ENIDE +	3.00	OT				
4	PARAQUAT	0.50	GK1	1954	3508	179.33	65.6
	COMMAND	0.50	GK1				
	COMMAND +	0.50	OT				
5	PARAQUAT	0.50	GK1				
	SCEPTER	0.06	GK1				
	SCEPTER	0.06	OT				
6	PARAQUAT	0.50	GK1				
	ENIDE	6.00	GK1				
	SCEPTER	0.13	BAN				
7	PARAQUAT	0.50	GK1				
	SCEPTER	0.13	POT				
	PP 005	0.25	POT				
8	DEVRINOL+	0.50	GK1				
	DEVRINOL	0.50	GK1				
	DEVRINOL	0.50	OT				
9	PARAQUAT+	0.50	GK1	1574	2855	177.94	66.6
	ENIDE	3.00	GK1				
	SCEPTER	0.13	POT				
	PP 005	0.25	POT				
10	PARAQUAT	0.50	GK1				
			LSD .15	NS	NS	NS	NS
			% CV	35	36	5.01	5

(YIELDS NOT TAKEN FOR THESE TREATMENTS)

*See Table 2 for explanation of abbreviations.

2000270261

Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

TABLE 16. Herbicie Evaluation Test in No-Till Tobacco, Reidsville, N.C., 1985.

				% Weed Control and Injury								Yield, Price and Quality					
TRT. NO.	HERBICIDE	LB AI/A	METHOD***	DIGSA 6-13	AMBEL 6-13	MOLVE 6-13	INJURY 6-13	DIGSA 7-3	AMBEL 7-3	MOLVE 7-3	INJURY 7-3	#/A	$/A	$/Cut	GRADE INDEX	% SUGAR	% TA (HY)
1	HOE 0661+	1.00	GKl	99	53	99	0	63	60	82	0	1555	2536	162.48	41	20.5	1.64
	ENIDE	3.00	GKl														
	ENIDE	3.00	OT														
2	ROUNDUP+	1.00	GKl	98	73	98	0	80	63	88	0	1822	3065	167.99	44	18.4	2.21
	ENIDE	3.00	GKl														
	ENIDE	3.00	OT														
3	PARAQUAT+	0.50	GKl	93	45	86	0	57	43	68	0	1326	2168	162.65	38	20.3	1.98
	ENIDE	3.00	GKl														
	ENIDE	3.00	OT														
4	PARAQUAT+	0.50	GKl	99	99	65	2	82	94	98	0	1655	2743	165.51	40	20.1	1.99
	COMMAND*	0.50	GKl														
	COMMAND*	0.50	OT														
5	PARAQUAT+	0.50	GKl	80	96	99	8	55	90	94	0	1251	2044	163.34	39	22.9	1.90
	SCEPTER	0.06	GKl														
	SCEPTER	0.06	OT														
6	PARAQUAT+	0.50	GKl	89	99	99	7	83	87	97	3	1763	2926	166.34	39	20.1	1.96
	ENIDE	6.00	GKl														
	SCEPTER	0.13	BAN														
7	PARAQUAT**	0.50	GKl	76	50	66	0	78	73	80	0	1153	1876	160.69	39	20.0	1.80
	SCEPTER	0.13	POT														
	PP 005	0.25	POT														
8	PARAQUAT+	0.50	GKl	97	56	93	0	93	70	64	0	1524	2501	162.75	38	19.5	1.91
	DEVRINOL	0.50	GKl														
	DEVRINOL	0.50	OT														
9	PARAQUAT+	0.50	GKl	33	30	47	0	65	63	65	0	1094	1799	162.97	37	20.1	1.69
	ENIDE	3.00	GKl														
10	PARAQUAT	0.50	GKl	32	23	33	0	0	48	48	0	813	1316	160.30	35	21.9	1.39
			LSD .05	40	56	56	6	28	NS	NS	NS	557	978	2.86	NS	NS	NS
			% CV	27	45	34	175	25	39	38	548	21	22	18	10	8	14

*Wheat planted in fall after tobacco harvest showed moderate yellowing as of February 1, 1986.

**Sequential applicagion..

***See Table 2 for explanation of abbreviations.

2000270262

Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

TABLE 17. Fertilization Test in No-Till Vs. Conventional Tobacco, Clayton, N.C., 1985.

TRT. NO.	TREATMENTS*	METHOD APPL.	Yield and Quality LBS/A	$/A	$/CWT	GRADE INDEX	% SUGAR	% TA (HY)
1	Standard (base plus sidedress) 60-65 # N	No-till	2362	4145	175.60	53.7	11.1	3.49
2	1/2 increase (base + sidedress) 85-90 # N	No-till	2210	3891	175.94	59.7	14.3	3.40
3	2X increase (base + sidedress) 110-120 # N	No-till	2297	4058	176.57	58.6	13.6	3.22
4	Broadcast/Standard Base + sidedress 60-65 # N	No-till	1853	3161	170.56	57.8	16.3	2.68
5	Broadcast, 1/2 increase base + sidedress 85-90 # N	No-till	2086	3624	173.56	59.2	14.8	2.86
6	Broadcast 2X increase base plus sidedress 110-120 # N	No-till	2236	3991	178.53	62.1	15.9	2.90
7	Standard (base + sidedress) 85-90 # N	Conv.	3574	6463	181.30	63.5	17.7	3.14
8	1/2 increase base + sidedress 85-90 # N	Conv.	3512	6366	181.18	66.6	18.5	3.04
9	2 X increase base plus sidedress 110-120 # N	Conv.	3772	6552	173.78	50.5	13.1	3.53
10	Broadcast standard base plus sidedress 60-65 # N	Conv.	3015	5435	179.64	70.1	22.1	2.67
11	Broadcast 1/2 increase base plus sidedress 85-90 # N	Conv.	3330	6066	180.85	67.0	18.1	3.01
12	Broadcast 2X increase base plus sidedress 110-120 # B	Conv.	3479	6316	181.03	63.2	18.2	3.11
		LSD .15	410	819	8.50	13	4.61	0.71
		% CV	10	12	2.60	12	19	13

*All plots of no-till sprayed with .5 lb a.i./A paraquat plus, plus 3.0 # a.i./A Enide 0T.

2000270263

Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

TABLE 18. No-Till Tobacco Variety Test, Clayton, N.C., 1985.

		Yield and Quality				
VARIETY	LBS/A	$/A	$/CWT	GRADE INDEX	% SUGAR	% TA (HY)
K-326	3015	5394	178.83	61.91	15.5	3.14
NF-28	3085	5503	178.28	63.05	16.7	2.88
C 319	2493	4413	177.21	58.83	15.2	3.19
NF-22	2454	4281	174.15	54.63	13.5	3.31
G-70	2597	4584	176.27	56.66	15.7	2.89
NC 82	2465	4407	178.79	61.68	16.2	2.94
LSD .5	252	469	5.32	5.60	NS	.36
% CV	10	10	2	9	17	10

2000270264

Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

TABLE 19. No-Till vs Conventional Burley Tobacco Herbicide Test, Waynesville, N.C., 1985.

TRT. NO	TREATMENT	RATE LB Ai/A	METHOD APPL***	CULTURAL PRACTICE	% Weed Control and Injury: CHEAL 6-18	DIGSA 6-18	INJURY 6-18	INJURY 8-5	DIGSA 8-5	CHEAL 8-5	Yield and Price: LBS/A	$/A	$/CWT	Overall yields and price, no-till vs conventional: LBS/A	$/A	$/CWT
1	Enide	6.0	OT	Convent.	92	97	1	0	99	75	3067	4515	147.42			
2	Devrinol	1.0	OT	Convent.	83	93	3	5	99	79	2856	4095	143.16			
3	Scepter	.125	OT	Convent.	96	91	19	8	99	84	3079	4516	146.68	2965	4361	147.03
4	Command*	1.0	OT	Convent.	98	99	1	3	99	93	2984	4448	148.99			
5	Enide plus Scepter** Plus Fusiliade 2000	6.0 .125 .20	OT POT POT	Convent.	96	96	3	6	99	71	2800	4194	149.20			
6	Cult Check	-	-	Convent.	0	0	0	10	50	45	3001	4398	146.75			
7	Paraquat plus Enide	.5	GK1	No-Till	96	99	9	9	98	90	3208	4745	147.65			
8	Paraquat plus Devrinol	.5	GK1	No-Till	94	96	0	0	99	91	2984	4366	146.31			
9	Paraquat plus Scepter	.50 .125	GK1 OT	No-Till	99	99	6	8	99	95	3060	4401	143.47	3050	4421	144.36
10	Paraquat* plus Command	.50 1.0	GK1 OT	No-Till	97	99	0	3	98	98	3107	4409	141.60			
11	Paraquat plus Enide plus Scepter88 plus Fusiliade	.50 6.0 .125 .20	GK1 OT POT POT	No-Till	99	91	3	0	98	90	3013	4268	141.66			
12	Paraquat	.5	GK1	No-Till	81	91	1	3	74	79	2975	4335	145.45			
	LSD .15				7	4	9	NS	4	6	NS	NS	NS	NS	NS	NS
	% CV				6	4	185	137	3	6	14	15	2.98	2.2	2.6	2.1

*Rye planted in fall after tobacco harvest showed severe yellowing and about 60% stand loss as of February 1, 1986.

**Sequential application

***See Table 2 for explanation of abbreviations.

2000270265

Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

APPENDIX

2000270266

Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

Table 0. Detailed Plot and Application Data for Surface Applied Tobacco Herbicide Evaluation Test in Tobacco, Kinston, N.C., 1985.

PLOT INFORMATION

1. Crop Varieties: McNair 944
2. Transplanting Dates: 4-23-85
3. Plot Size: 3 Rows (2 treated, 1 border) X 40 ft.
4. Row Spacing: 45"
5. Plant Spacing: 22"
6. Stand Establishment: 40 plants/plot
7. Experimental Design: RCB
8. Replications: 4
9. Soil Type: Lynchburg sandy loam
10. Percent Organic Matter: .9
11. Soil pH: 6.4
12. Type Sprayer: CO_2
13. Diluent/Carrier: H_2O
14. Spray Volume: OT = 19.1
15. Pressure (PSI): 20
16. Type Nozzle: Whirl-chamber
17. Nozzle Size: 49 x 49
18. Nozzles/Row: 2 1/2
19. Nozzles Spacing: 20"
20:

Appl'n Date	Method of Appl'n	Weeds Present & Density
5-31-85	OT	None

2000270267

Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

Table 1. Detailed Plot and Application Data for Herbicide Evaluation Test in Tobacco, Rocky Mount, N.C., 1985.

PLOT INFORMATION

1. Crop Variety: McNair 944
2. Transplanting Dates: 4-25-85
3. Plot Size: 3 Rows (1 border, 2 treated) X 45 ft.
4. Row Spacing: 45"
5. Plant Spacing: 22"
6. Stand Establishment: 40 plants/plot
7. Experimental Design: RCB
8. Replications: 3
9. Soil Type: Shubata loamy sand
10. Percent Organic Matter: 1.0
11. Soil pH: 6.6
12. Type Sprayer: CO_2 backpack
13. Diluent/Carrier: H_2O
14. Spray Volume: PBI, OT, = 19.1/GPA LBY = 19.1 GPA
15. Pressure (PSI): 20
16. Type Nozzle: Whirl-chamber
17. Nozzle Size 49 x 49
18. Nozzles/Row: 2 1/2
19. Nozzles Spacing: 20"
20. Appl'n Date Method of Appl'n Weeds Present & Density

4-19-85	PBI	None
4-25-85	OT	None
5-20-85	LBY	None

Weeds rating based on:
Large crabgrass 1 sq. ft.
Common purslane 1 sq. ft.
Redroot pigweed 1 sq. ft.
Tall morningglory 1 sq. ft.

200027026B

Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

Table 2. Detailed Plot and Application Data for Overtop Applied Herbicide Evaluation Test in Tobacco, Kinston, N.C., 1985.

PLOT INFORMATION

1. Crop Variety: McNair 944
2. Transplanting Dates: 4/19/85
3. Plot Size: 3 Rows (2 treated, 1 border) x 40 ft.
4. Row Spacing: 45"
5. Plant Spacing: 22"
6. Stand Establishment: 40 plants/plot
7. Experimental Design: RCB
8. Replications: 4
9. Soil Type: Lynchburg sandy loam
10. Percent Organic Matter: .9
11. Soil pH: 6.4
12. Type Sprayer: CO_2
13. Diluent/Carrier: H_2O
14. Spray Volume: OT-19.1 LBY = 19.1 GPA
15. Pressure (PSI): 20
16. Type Nozzle: Whirl-chamber
17. Nozzle Size 49 x 49
18. Nozzles/Row: 2 1/2
19. Nozzles Spacing: 20"
20.

Appl'n Date	Method of Appl'n	Weeds Present & Density
4-22-85	OT	None
6-4-85	LBY	None

200027026

Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

Table 3. Detailed Plot and Application Data for Scepter Evaluation in Flue-Cured Tobacco, Clayton, N.C., 1985.

PLOT INFORMATION

1. Crop Variety: McNair 944
2. Transplanting Dates: 5/6/85
3. Plot Size: 3 Rows (2 treated, 1 border) x 43 ft.
4. Row Spacing: 45"
5. Plant Spacing: 22"
6. Stand Establishment: 40 plants/plot
7. Experimental Design: RCB
8. Replications: 4
9. Soil Type: Gilead sandy loam, Johns sandy loam, Bibbs soils
10. Percent Organic Matter: 1.0
11. Soil pH: 6.6
12. Type Sprayer: CO_2
13. Diluent/Carrier: H_2O
14. Spray Volume: Sur, OT, LBY = 19.1 GPA
15. Pressure (PSI): 20
16. Type Nozzle: Whirl-chamber
17. Nozzle Size 49 x 49
18. Nozzles/Row: 2 1/2
19. Nozzles Spacing: 20"
20. Appl'n Date / Method of Appl'n / Weeds Present & Density

Appl'n Date	Method of Appl'n	Weeds Present & Density
5-10-85	Surface	None
5-22-85	OT	None
6-11-85	LBY	None

2000270270

Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

Table 4. Detailed Plot and Application Data for Imazaquin Evaluation Test in Flue-Cured Tobacco, Reidsville, N.C., 1985.

PLOT INFORMATION

1. Crop Variety: NC 82
2. Transplanting Dates: 5-14-85
3. Plot Size: 3 Rows (2 treated, 1 border) x 42 ft.
4. Row Spacing: 45"
5. Plant Spacing: 22"
6. Stand Establishment: 40 plants/plot
7. Experimental Design: RCB
8. Replications: 3
9. Soil Type: Cecil Clay Loam
10. Percent Organic Matter: 0.9
11. Soil pH: 6.6
12. Type Sprayer: CO_2
13. Diluent/Carrier: H_2O
14. Spray Volume: Sur, OT, LBY = 19.1 GPH
15. Pressure (PSI): 20
16. Type Nozzle: Whirl-chamber
17. Nozzle Size: 49 x 49
18. Nozzles/Row: 2 1/2
19. Nozzles Spacing: 20"
20:

Appl'n Date	Method of Appl'n	Weeds Present & Density
5-5-85	Sur	None
5-14-85	OT	None
6-27-85	LBY	None

20002702?1

Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

Table 5. Detailed Plot and Application Data for Postemergence Grass Herbicide Test in Tobacco, Reidsville, N.C., 1985.

PLOT INFORMATION

1. Crop Variety: NC 82
2. Transplanting Dates: 5/24/85
3. Plot Size: 3 Rows (1 treated, 2 borders) X 43 ft.
4. Row Spacing: 45"
5. Plant Spacing: 22"
6. Stand Establishment: 44 plants/plot
7. Experimental Design: RCB
8. Replications: 4
9. Soil Type: Cecil clay loam
10. Percent Organic Matter: 0.9
11. Soil pH: 6.5
12. Type Sprayer: CO_2 backpack
13. Diluent/Carrier: H_2O
14. Spray Volume: OT, POT = 19.1, LBY = 19.1 GPA
15. Pressure (PSI): 20
16. Type Nozzle: Whirl-chamber
17. Nozzle Size 49 x 49
18. Nozzles/Row: 2 1/2
19. Nozzles Spacing: 20"
20.

Appl'n Date	Method of Appl'n	Weeds Present & Density
5-28-85	POT	Large crabgrass 1-5/sq. ft. 1-2 leaf stage

20002702272

Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

Table 7. Detailed Plot and Application Data for No-Till Flue Cured Tobacco Herbicide Evaluation Test, Clayton, N.C., 1985.

PLOT INFORMATION

1. Crop Variety: McNair 944
2. Transplanting Dates: 5-6-85
3. Plot Size: 3 Rows (1 border, 2 treated) X 45 ft.
4. Row Spacing: 45"
5. Plant Spacing: 22"
6. Stand Establishment: 40 plants/plot
7. Experimental Design: RCB
8. Replications: 4
9. Soil Type: Gilead sandy loam
10. Percent Organic Matter: 1.1
11. Soil pH: 6.5
12. Type Sprayer: CO_2 backpack
13. Diluent/Carrier: H_2O
14. Spray Volume: At grain-kill (GK1), OT, POT = 19.1 GPA
15. Pressure (PSI): 20
16. Type Nozzle: Whirl-chamber
17. Nozzle Size 49 x 49
18. Nozzles/Row: 2 1/2
19. Nozzles Spacing: 20"
20.

Appl'n Date	Method of Appl'n	Weeds Present & Density
4-17-85	GK1	Rye 4 to 6 ft.
5-8-85	OT	None
5-27-85	POT	Common Ragweed 1 sq. ft. 2-5"
		Tall morningglory 1 sq. ft., 2-6 leaf
		Common lambsquarters 1 sq. ft., 2-4 leaf
		Redroot pigweed 1 sq. ft. 2-4 leaf

20002202273

Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

Table 6. Detailed Plot and Application Data for Herbicide Evaluation Test in Burley Tobacco, Waynesville, N.C., 1985.

PLOT INFORMATION

1. Crop Variety: GR 136 (TN 86)
2. Transplanting Dates: 5-23-85
3. Plot Size: 2 Rows (2 treated) x 35 ft.
4. Row Spacing: 48"
5. Plant Spacing: 10"
6. Stand Establishment: 40 plants/plot
7. Experimental Design: RCB
8. Replications: 4
9. Soil Type: Dyke Clay Loam
10. Percent Organic Matter: 1.2
11. Soil pH: 6.2
12. Type Sprayer: CO_2 backpack
13. Diluent/Carrier: H_2O
14. Spray Volume: Sur, OT, LBY = 19.1 GPH
15. Pressure (PSI): 20
16. Type Nozzle: Whirl-chamber
17. Nozzle Size: 49 x 49
18. Nozzles/Row: 2 1/2
19. Nozzles Spacing: 20"
20:

Appl'n Date	Method of Appl'n	Weeds Present & Density
5-22-85	Sur	None
5-23-85	OT	None
8-5-85	LBY	None

20002074

Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

Table 8. Detailed Plot and Application Data for Fertilization Test in No-Till and Conventional Tobacco, Clayton, N.C., 1985.

PLOT INFORMATION

1. Crop Variety: McNair 944
2. Transplanting Dates: 5-6-85
3. Plot Size: 2 Rows (No border) X 45 ft.
4. Row Spacing: 45"
5. Plant Spacing: 22"
6. Stand Establishment: 40 plants/plot
7. Experimental Design: RCB
8. Replications: 4
9. Soil Type: Gilead sandy loam
10. Percent Organic Matter: 1.1
11. Soil pH: 6.5
12. Type Sprayer: CO_2 backpack
13. Diluent/Carrier: H_2O
14. Spray Volume: GK1, OT, = 19.1 GPA
15. Pressure (PSI): 20
16. Type Nozzle: Whirl-chamber
17. Nozzle Size 49 x 49
18. Nozzles/Row: 2 1/2
19. Nozzles Spacing: 20"
20.

Appl'n Date	Method of Appl'n	Weeds Present & Density
4-17-85	GK1 (Paraquat)	Rye 4 to 6 ft.
5-8-85	OT (Enide)	None
5-27-85	POT (Scepter)	Common Ragweed <1 sq. ft. 2-5"
		Tall morningglory <1 sq. ft. 2-6 leaf
		Common lambsquarters <1 sq ft. 2-4 leaf.
		Redroot pigweed <1 sq. ft. 2-4 leaf

20002702275

Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

Table 9. Detailed Plot and Application Data for No-Till Tobacco Herbicide Evaluation Test, Reidsville, N.C., 1985.

PLOT INFORMATION

1. Crop Variety: NC 82
2. Transplanting Dates: 1st May 9, Reset May 15
3. Plot Size: 3 Rows (2 treated, 1 border) X 42 ft.
4. Row Spacing: 45"
5. Plant Spacing: 22"
6. Stand Establishment: 40 plants/plot
7. Experimental Design: RCB
8. Replications: 4
9. Soil Type: Cecil clay loam
10. Percent Organic Matter: 0.9
11. Soil pH: 6.6
12. Type Sprayer: CO_2
13. Diluent/Carrier: H_2O
14. Spray Volume: At grain-kill (GK1), OT, POT = 19.1 GPA
15. Pressure (PSI): 20
16. Type Nozzle: Whirl-chamber
17. Nozzle Size 49 x 49
18. Nozzles/Row: 2 1/2
19. Nozzles Spacing: 20"
20.

Appl'n Date	Method of Appl'n	Weeds Present & Density
5-1-85	GK1	Rye 4 to 6 ft.
5-9-85	OT	None
5-28-85	POT	Common Ragweed <1 sq. ft. 2-6"
		Large Crabgrass <1 sq. ft. 2-4 leaf
		Common lambsquarters <1 sq. ft., 2-4 leaf
		Carpetweed <1 sq. ft., 2-4 leaf

9420220276

Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

Table 10. Detailed Plot and Application for No-Till Tobacco Variety Test, Clayton, N.C., 1985.

PLOT INFORMATION

1. Crop Varieties: NF 28, NF 22, Coker 319, NC 82, K 326, G 70
2. Transplanting Dates: 5-7-85
3. Plot Size: 1 Row X 42 ft.
4. Row Spacing: 45"
5. Plant Spacing: 22"
6. Stand Establishment: 20 plants/plot
7. Experimental Design: RCB
8. Replications: 8
9. Soil Type: Gilead sandy loam
10. Percent Organic Matter: 1.1
11. Soil pH: 6.4
12. Type Sprayer: CO_2 backpack
13. Diluent/Carrier: H_2O
14. Spray Volume: PBI, SUR, OT = 19.1 GPA LBY = 19.1 GPA
15. Pressure (PSI): 20
16. Type Nozzle: Whirl-chamber
17. Nozzle Size: 49 x 49
18. Nozzles/Row: 2 1/2
19. Nozzles Spacing: 20"
20:

Appl'n Date	Method of Appl'n	Weeds Present & Density
4-17-85	GKI	Rye (4-5 ft. tall)
5-8-85	OT	None
5-27-85	POD(Fusliade)	Large crabgrass 1-3 sq. ft.. 2-3"

2000270277

Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

Table 11. Detailed Plot and Application Data for No-Till vs. Conventional Burley Tobacco Herbicide Test, Waynesville, N.C., 1985.

PLOT INFORMATION

1. Crop Variety: GR 136 (TN 86)
2. Transplanting Dates: 5-23-85
3. Plot Size: 2 Rows (2 treated) x 35 ft.
4. Row Spacing: 45"
5. Plant Spacing: 22"
6. Stand Establishment: 40 plants/plot
7. Experimental Design: RCB
8. Replications: 4
9. Soil Type: Dyke Clay Loam
10. Percent Organic Matter: 1.2
11. Soil pH: 6.2
12. Type Sprayer: CO_2 backpack
13. Diluent/Carrier: H_2O
14. Spray Volume: At grain-kill (GKl) and OT = 19.1 GPA
15. Pressure (PSI): 20
16. Type Nozzle: Whirl-chamber
17. Nozzle Size: 49 x 49
18. Nozzles/Row: 2 1/2
19. Nozzles Spacing: 20"
20:

Appl'n Date	Method of Appl'n	Weeds Present & Density
5-7-85	GKI	Rye 4-6 ft. tall
5-23-85	OT	None 8-11-85
8-11-85	POT(Scepter)	Common lambsquarters < 1 sq. ft.
8-12-85	POT (Fusilade 2000)	Large crabgrass < 1 sq.ft.

20002702078

Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

TABLE 12.

RAINFALL

Central Crops Research Station

Clayton, NC 1985

Date	April	May	June	July	August
1	0	0	0	.42	0
2	0	.02	0	.22	.01
3	0	.24	0	0	0
4	0	0	0	0	0
5	0	0	.28	0	0
6	.09	0	.01	.31	0
7	0	0	.10	.01	0
8	0	0	.01	0	0
9	0	0	0	0	0
10	0	.03	.03	.50	0
11	0	0	0	.03	0
12	0	.87	.34	0	0
13	0	0	0	0	0
14	.02	0	0	0	0
15	0	0	0	0	0
16	2.12	.31	1.22	.41	0
17	.01	0	.03	0	.37
18	0	0	.01	0	.39
19	0	0	0	0	.01
20	0	0	0	0	0
21	0	.26	0	0	1.01
22	0	0	0	.02	0
23	0	.05	0	0	0
24	0	.01	0	.49	.01
25	0	0	0	2.14	.42
26	0	0	0	.24	0
27	0	0	0	.16	0
28	0	0	0	1.33	0
29	0	0	.28	.13	.03
30	0	0	.40	0	0
31		0		.13	0
Total	2.24	1.79	2.71	6.54	2.25

20002702279

Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

TABLE 13.

RAINFALL

Upper Coastal Plain Research Station

Rocky Mount, NC 1985

Date	April	May	June	July	August
1	0	0	0	1.16	0
2	0	0	0	.20	3.12
3	0	.43	0	0	.02
4	0	0	0	0	0
5	0	0	0	0	0
6	.05	0	1.90	0	0
7	0	0	0	.62	0
8	0	0	.02	0	0
9	0	0	0	0	0
10	0	0	0	0	.03
11	0	.14	0	3.40	0
12	0	.02	0	0	0
13	0	0	.60	.11	0
14	.07	0	0	0	0
15	T	0	0	0	0
16	0	0	.66	.84	0
17	.17	0	.68	.02	0
18	0	0	.06	0	.60
19	0	0	.27	0	.70
20	0	0	0	0	0
21	0	0	0	0	.05
22	0	.27	0	0	0
23	0	.02	0	0	0
24	0	.50	0	0	0
25	0	0	0	1.99	.56
26	0	0	0	.75	0
27	0	0	0	1.15	0
28	0	0	0	.90	0
29	0	0	0	.27	0
30	0	0	.24	0	0
31		0		0	0
Total	.29	1.38	4.43	11.41	5.08

20002702280

Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

TABLE 14.

RAINFALL

Lower Coastal Plain Tobacco Research Station

Kinston, NC 1985

Date	April	May	June	July	August
1	0	0	0	0	0
2	0	0	0	0	.71
3	0	.20	0	0	0
4	0	0	0	0	0
5	0	0	0	.72	0
6	0	0	.17	.35	0
7	0	0	0	.13	.22
8	0	.01	.03	0	.14
9	0	.02	0	0	.11
10	0	0	0	0	0
11	0	.34	0	1.20	0
12	0	0	0	0	0
13	0	0	0	.10	0
14	.33	0	0	.10	0
15	0	.54	0	0	0
16	0	0	.32	.75	0
17	.15	0	0	.06	.73
18	0	0	0	.29	.47
19	0	0	.17	0	1.35
20	0	0	0	0	0
21	0	0	0	0	0
22	0	.14	0	.19	.46
23	0	.10	0	.10	0
24	0	0	0	.52	0
25	0	0	0	2.57	.25
26	0	0	0	.03	0
27	0	0	0	2.08	0
28	0	0	0	.15	0
29	0	.09	0	0	0
30	0	0	.45	0	0
31		0		0	0
Total	.48	1.44	1.14	9.34	4.44

2000270281

Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

TABLE 15

RAINFALL

UPPER PIEDMONT Research Station

REIDSVILLE, N.C. 1985

Date	May	June	July	Aug.	Sept.
1			.16	.46	
2	T		.12	.44	
3	.47				
4					
5		T	.06		
6		.03	1.03		
7		.47	.02	.03	
8		.28		.12	
9				.02	
10					
11			.68		
12	.48	.34			
13					
14			.52		
15					
16	1.58	.26	.14		
17	.23	.31	.55	T	
18	.10			2.86	
19				.50	
20					
21				2.65	
22	.37			.39	.05
23	.31				
24	.13				T
25	.08		.35	.31	
26			1.94	.08	
27			.03	.39	
28			.13	.22	
29	T		.09		
30					
31		.35		.18	
Total	3.75	2.04	5.82	8.55	.05

2000270282

Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

TABLE 16

RAINFALL

MOUNTAIN Research Station

WAYNESVILLE, N.C. 1985

Date	May	June	July	Aug.	Sept.
1			.28	.39	
2	.01	.07	.12		
3	.23				T
4					
5			T		
6		.14	.24	.04	T
7		.47		.34	.06
8	.58	.28		T	1.45
9	.38			.26	.02
10	.02	.03			T
11	.02	.12	.18		
12	.03	.13		.08	.17
13	.08		.05	.03	
14	T				
15	.11		.23		
16	.05			T	
17	.38			1.84	
18	.04	.41		.04	
19					
20		.01			
21			.30	.09	
22	T		T		
23	T	.03	.17	.02	
24	.04	.03	.11	.12	.09
25			.71	.19	
26		T	.02	.11	.15
27			.58	T	.10
28	.09		.57		.02
29		.04	.01		
30		.54		.32	
31			.13		
Total	2.06	2.30	3.84	3.87	1.96

20002702B3

Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

Title: Regulation of Carbon and Nitrogen Assimilation

Project Leader: Thomas W. Rufty, Jr.

I. Summary of Research:

During the past year, several investigations were initiated to characterize mechanisms involved in the control of carbon and nitrogen assimilation in crop plants. Particular aspects examined in detail were; a) regulation of sucrose formation and utilization during the light-dark cycle, b) control of coordination among components of the photosynthesis system as plants acclimated to the temperature of the growth environment, and c) an evaluation of the method in which rates of NO_3^- reduction in roots are estimated using NO_3^- and reduced-N concentration ratios in xylem sap.

Diurnal patterns of nonstructural carbohydrate (starch, sucrose, and hexose sugars) concentration were characterized in plant parts (leaves, petioles, stems, and roots). Pronounced changes in all carbohydrate pools were observed during the normal photosynthetic period; however, starch accumulation within leaves accounted for more then 80% of the nonstructural carbohydrate accumulated by the plant during the light period. Efficiency of utilization of starch and sucrose during the normal dark period differed among organs, with leaves being most efficient in mobilizing starch reserves and roots being most efficient in utilizing sucrose reserves. The vast majority (about 85%) of the whole plant carbohydrate reserves present at the end of the photosynthetic period were utilized during the normal dark period. Sink leaf expansion ceased in plants transferred to extended darkness and the cessation in leaf expansion corresponded with carbohydrate depletion in the subtending source leaf and the remainder of the plant. The results indicated that under the conditions employed, leaves are the whole plant's primary source of carbon at night as well as during the day.

Experiments were conducted to determine if diurnal rhythms in net carbon dioxide exchange rate (CER), stomatal resistance, and sucrose-phosphate synthase (SPS) activity persisted in constant environmental conditions (constant light, LL; constant dark DD) and to assess the importance of these rhythms to the production of nonstructural carbohydrates (starch, sucrose, and hexose). Rhythms in CER, stomatal resistance, and SPS activity were observed in constant environmental conditions but the rhythms differed in period length, amplitude, and phase. The results indicated that these photosynthetic parameters are not controlled in a coordinated manner. The activity of UDPG pyrophosphorylase, another enzyme involved in sucrose formation, did not fluctuate rhythmically in constant conditions but increased with time in plants in LL. In LL, the rhythm in CER was correlated positively with fluctuations in total chlorophyll ($r=0.810$) and chlorophyll a ($r=0.791$) concentrations which suggested that changes in pigment concentration were associated with, but not necessarily the underlying mechanism of, the rhythm in photosynthetic rate. Assimilate export rate, net starch accumulation rate, and leaf sucrose concentration also fluctuated in constant light. No single photosynthetic parameter was closely correlated with fluctuations in assimilate export during LL; thus, assimilate export may

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Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

have been controlled by interactions among the endogenous rhythms in CER, SPS activity, or other metabolic factors which were not measured in the present study.

Plants were grown at three aerial temperatures to examine the relationship between sucrose-phosphate synthase (SPS) activities of leaves and whole-plant growth rate. Plants were exposed for 17 days to day/night temperatures of 26/22°C, 22/18°C, or 18/14°C, which resulted in a progressive lowering of relative growth rates (0.129, 0.109 and 0.067 g g^{-1} day^{-1}, respectively). Net CO_2 exchange rates (CER), SPS activities and calculated assimilate export rates of the most recently expanded trifoliolate leaf in the canopy were decreased at lower temperatures. The temperature effects were reversible, as CER and SPS activities of selected expanded leaves were increased within 3 days after plants were switched from 18/14°C to 30/26°C and decreased following transfer from 26/22°C to 18/14°C. The results are interpreted as evidence that changes in the activity of SPS are an integral part of the coordinated adjustments in the leaf phostosynthetic system which limit formation and export of sucrose as the temperature in the growth environment declines.

Distinctly different patterns of ^{15}N enrichment were observed in the nitrate and reduced-N fractions of xylem exudate from soybean plants during and after 5 to 6 days of exposure to $^{15}NO_3^-$. Within 1 d after changes in solution NO_3^- label, more than 90% of the exudate NO_3^- originated from the exogenous supply. Alterations in the enrichment of exudate reduced-N were much slower, however, and the enrichment reached only 40% even after 5 d of continuous exposure to $^{15}NO_3^-$. Taking into account possible reduction of endogenous NO_3^- and delayed translocation of NO_3^- reduction products, it was concluded that root reduction could have contributed only 30 to 42% of the reduced-N found in the exudate. It is clearly invalid to use relative amounts of NO_3^- and reduced-N in xylem exudate to estimate root NO_3^- reduction in soybean. Additional evidence currently being gathered suggests that this may extend to tobacco and other crops as well.

II. Graduate Students: none

III. Postdoctoral Fellows: none

IV. Publications:

Rufty, T. W., Jr., S. C. Huber, and P. S. Kerr. 1985. Association between sucrose-phosphate synthase activity in leaves and plant growth rate in response to altered aerial temperature. Plant Science 39:7-12.

Huber, S. C., P. S. Kerr, and T. W. Rufty. 1985. Diurnal changes in sucrose phosphate synthase activity in leaves. Physiol. Plantarum 64:81-87.

2000270285

Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

Kerr, P. S., T. W. Rufty, Jr., and S. C. Huber. 1985. Changes in nonstructural carbohydrates in different parts of soybean plants during a light/dark cycle and in extended darkness. Plant Physiol. 78:576-581.

Kerr, P. S., T. W. Rufty, Jr., and S. C. Huber. 1985. Endogenous rhythms in photosynthesis, sucrose phosphate synthase activity, and stomatal resistance in leaves of soybean. Plant Physiol. 77:275-280.

Rufty, T. W., Jr. 1985. Using root biochemistry and physiology to improve corn productivity. In the Physiology, Biochemistry, and Chemistry Associated with Maximum Yield of Corn. R. D. Munson, ed. Foundation for Agric. Res., Publisher.

V. Manuscripts Accepted for Publication:

Rufty, T. W., Jr. and R. J. Volk. 1986. Alterations in enrichment of NO_3^- and reduced-N in xylem exudate during and after extended plant exposure to $^{15}NO_3^-$. Plant and Soil 91: In Press.

Kerr, P. S., D. W. Israel, S. C. Huber, and T. W. Rufty, Jr. 1986. Effect of supplemental NO_3^- on plant growth and components of photosynthetic carbon metabolism in soybean. Canadian J. Botany. In Press.

VI. Manuscripts in Review:

Cure, J. D., T. W. Rufty, Jr., and D. W. Israel. Assimilate utilization in the leaf canopy and whole-plant growth of soybean during acclimation for elevated CO2. Canadian J. of Botany.

Rufty, T. W., J. F. Thomas, J. L. Remmler, W. H. Campbell, and R. J. Volk. Intercellular localization of nitrate reductase in roots. Plant Physiology.

VII. Papers Presented at Professional Meetings:

Cure, J. D., T. W. Rufty, Jr., and D. W. Israel. 1985. Growth and carbohydrate responses of soybean plants exposed to CO_2 enrichment. Annual Meeting of the American Society of Plant Physiologists, Brown University, Providence, R. I. June, 1985.

Kerr, P. S., S. C. Huber, and T. W. Rufty, Jr. 1985. Diurnal rhythms in sucrose phosphate synthase in leaves of field-grown soybean plants as influenced by stage of development. Annual Meeting of the American Society of Plant Physiologists, Brown University, Providence, R. I. June, 1985.

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VIII. Graduate Student Theses Completed During Reporting Period: none

IX. Acknowledgements:

Appreciation is extended to William G. Woodlief for excellent technical assistance.

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Title: NC 05539 Nicotiana tabacum Carbohydrate Biochemistry

Project Leader: David A. Danehower

1. Summary of Research

A. Introduction

The goal of this project is the development of analytical and preparative methods for the isolation and analysis of the sucrose esters and other leaf constituents of Nicotiana tabacum. Our approach has been to identify compounds for which no rapid method of analysis or isolation exists and to develop such methods. Important criteria for the methods developed are that they be cost effective, rapid, reproducible, and that there be obvious applications for the method by us or in cooperation with other tobacco researchers.

To date, several methods meeting these criteria have been developed. These include:

1. Sucrose Ester Analysis (GC)
2. Total Leaf Surface Profiling (GC)
3. Cis-abienol Method (LC)
4. Leaf Pigment Analysis (LC)
5. Nucleotide Analysis (LC)
6. Neutron Activation Analysis of Inorganics in Tobacco (NAA)
7. Preparative Isolation of Tobacco Leaf Surface Constituents (LC)

We are applying these methods either ourselves, or in cooperation with others in the following studies:

1. Leaf Surface and Endogenous Chemistry of U. S. and S. A. Genotypes: Influence of Growth, Maturation, and Curing (Methods 1-3,& 6) In cooperation with R.C. Long, W. W. Weeks, and E. A. Wernsman.

2. Leaf Surface Chemistry of U. S. and S. A. Genotypes: Influence of Rainfall and Overhead Irrigation (Methods 1-3).

3. DNA Amplification in Anther-Derived Haploids and its Relationship to Changes in Tobacco Metabolism (Method 4) In cooperation with Dr. E. A. Wernsman and Mr. C. H. Yung.

4. Isolation and Biological Testing of Nicotiana Leaf Surface Constituents (Methods 1-3, and 7) In cooperation with Mr. David Lawson and other tobacco researchers.

5. Mapping of Flue-Cured and Burley Inorganic Constituents During Curing using Neutron Activation Analysis. (Method 6) In cooperation with Dr. Jack Brenizer (UVA) and Doctors Bob Jenkins, Harvey Grubbs, Richard Newman and Mr. Roger Bass (Philip-Morris, Inc.).

B. Summary of Progress

1. Leaf Surface and Endogenous Chemistry of U. S. and S. A. Genotypes: Influence of Growth, Maturation, and Curing.

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McNair 944, Kentucky 17, Samsun, Galpao comun, Amerlinja, and Brazil Special (flue-cured, burley, oriental, and three South American type tobaccos, respectively) were grown at the Border Belt Research Station in 1984 and 1985. Cultural practices were typical for flue-cured tobaccos except for Kentucky 17, which was grown under a high N, burley type regimen.

Leaves from all types were primed when optimally ripe (Kentucky 17 was also stalk cut) and subjected to flue- or air-curing regimes. The Samsun tobacco was also sun-cured in the traditional manner. Three air-curing regimes were used: slow, medium, and fast. Burner pilot lights and ventilation in the stick barns were controlled to give the different curing rates.

Analyses of green samples indicated that exogenous chemistries (and therefore flavor chemistry of the cured materials) differed significantly. McNair 944, Brazil Special, and Kentucky 17 are primarily producers of duvanes whereas the other tobaccos produce not only duvanes but labdanes as well. In addition the Samsun and Galpao tobaccos produce sucrose esters, a third group of important leaf surface flavor precursors.

Analyses of labdane containing tobaccos during curing indicate that cis-abienol, the predominant labdane in tobacco, decreased rapidly during flue- or sun-curing and less rapidly during air-curing. Levels of abienol were virtually undetectable in fully-cured tobaccos, regardless of curing regime. Duvanes, on the other hand, degrade at a slower rate and are still present in cured leaf. Studies have indicated the formation of several labdane breakdown products in cured leaf. Labdanes thus appear to be particularly subject to oxidative degradation during curing. Since there is considerable interest in transferring this character to flue-cured tobaccos, thought should be given to modification of traditional flue-curing processes for such tobaccos. Otherwise what is gained genetically may be lost "up the flue" during the curing process.

Endogenous components have also been analyzed. Total alkaloids ranged from 1.29% (sun-cured Samsun) to 2.85% (stalk-cured Burley). In order of decreasing alkaloid content, these tobaccos ranked thusly: Kentucky 17 > McNair 944 ≅ Amerlinja > Samsun > Galpao comun. Within a given cultivar, alkaloid content was approximately the same regardless of curing regime with one exception. Sun-cured oriental (Samsun) contained approximately 2/3 the total alkaloids of flue-cured material (1.29% vs 2.06%), averaged over 3 stalk positions).

Reducing sugars varied considerably amongst the cultivars. Normal levels were found in flue-cured McNair 944 (Average 22.5%) with sugar/alkaloid (S/A) ratios of approximately 9. Air-cured McNair 944 sugar values were roughly 1/2 of their flue-cured counterparts. S/A values averaged 6.2 over all stalk positions.

Sugar content in the burley, oriental and S.A. cultivars was much lower for either flue- or air-cured treatments. Average sugar content and S/A ratios for these tobaccos over all stalk positions were as follows: Air-cured Kentucky 17 - 3% and 1.4, stalk-cured Kentucky 17 - 2.8% and 1.0; air-cured Galpao 3.8% and 2.9%, flue-cured Galpao 4.0% and 2.7%; air-cured Amerilinja 2.5% and 1.1%, flue-cured Amerlinja 4.7% and 2.2%; air-cured Brazil Special 3.9% and 2.5%, flue-cured Brazil Special 6.3% and 4.5%; sun-cured Samsun 7.6% and 5.9%, and flue-cured Samsun 9.0% and 4.4%.

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Thus, all of the South American varieties were grossly deficient in reducing sugars regardless of curing and the Samsun oriental tobacco was marginal at best. A result of this low sugar content was the inability of these tobaccos to hold moisture well and a resultant tendency to shatter.

2. Leaf Surface Chemistry of U. S. and S. A. Cultivars: Influence of Rainfall and Overhead Irrigation.

McNair 944, Brazil Special, Amerlinja, and Galpao comun tobaccos were grown in a split plot design with three replications during the 1985 growing season at the Central Crops Research Station. Irrigation was begun approximately three weeks prior to the harvest and continued on a periodic basis for two weeks. Leaf disks were taken before and after application of water. Analyses are currently underway in our laboratory.

Our purpose in this experiment is to quantify the losses of various leaf surface (flavor precursor) components during rains or overhead irrigation. It is our hypothesis that significant quantities of leaf surface components are removed during the application of water. Thus, while irrigation allows a farmer to increase yields in dry years, he may also be losing components which contribute to the flavor quality of his crop.

3. DNA Amplification in Anther-Derived Haploids and its Relationship to Changes in Tobacco Metabolism.

In cooperation with Dr. E. A. Wernsman and Mr. Carl Yung, we have developed a rapid method for the analysis of tobacco leaf pigments. This method is being applied to the examination of pigmentation differences in anther-derived dihaploids and homozygous parent lines. Differences in pigmentation are obvious between these lines in the field. Our goal is to quantitate these differences as an initial measure of the metabolic dissimilarity of these plant materials.

4. Isolation and Biological Testing of Nicotiana Leaf Surface Constituents.

Preparative methods for the isolation of Nicotiana leaf surface constituents are currently being developed in our lab. Initial fractionations are carried out on Sephadex LH-20 using methylene chloride:methanol mobile phases. Fractions generated by this procedure are then further separated using moderate or high pressure liquid chromatographic procedures utilizing normal and reversed phase partitioning columns.

Cooperative arrangements are being made with a number of tobacco faculty to test these materials for biological activity towards tobacco pathogens, insects, and competitive weed species.

5. Mapping of Flue-Cured and Burley Inorganic Constituents during Curing Using Neutron Activation Analysis.

McNair 944 and Kentucky 17 used in the experiments outlined in Section 1 above were also sampled for inorganic analysis by N.A.A. Samples were taken at three stalk positions and included stalk sections, midribs, and lamina from various positions on the leaf. Tissues were freeze-dried, pulverized, and

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analyzed by N.A.A. for a number of inorganic elements at the University of Virginia Nuclear Reactor Facility by Dr. Jack Brenizer. N.A.A. is an excellent technique for such analyses as it requires no sample preparation and permits simultaneous quantitation of numerous elemental species.

Analyses for McNair 944 indicate differences in concentration of certain elements as a function of position within a leaf. For example, Magnesium is found in higher concentration at the base of a leaf or near the midrib than at the tips or margins. Calcium is also in higher concentration at the base, although no significant difference exists between lamina near the midrib vs the margin. Potassium increases near the tips and midrib of the leaf. Chlorine is high in midrib and tissues adjacent to it as well as in the base of the leaf.

II. Graduate Students:

Mr. David Lawson, M.S. candidate; Thesis topic: Chromatographic Isolation and Analyses of Nicotiana Leaf Surface Components.

IV. Publications:

Danehower, D. A., R. C. Long, and W. W. Weeks. Influence of genotype, ontogeny, and curing on cis-abienol levels. 39th Tobacco Chemists' Research Conference, Montreal, Canada. October 2-5, 1985. Abstracts p. 13.

Schell, L. P., J. R. Anderson, D. A. Danehower, and R. P. Patterson. The relationship of adenylate levels in corn embryos to field emergence and vigor of selected corn varieties. Am. Society of Agronomy National Meeting. Chicago, IL. December 1-6, 1985. Agronomy Abstracts p. 105.

V. Manuscripts Accepted for Publication: None

VI. Manuscripts in Review:

Shilling, D. G., A. D. Worsham, and D. A. Danehower. The effect of mulch, tillage, and herbicides on weed control, yield, and quality of flue-cured tobacco. Weed Science.

Danehower, D. A. A rapid method for the isolation and analysis of the sucrose esters of tobacco. Tobacco Science.

VII. Papers Presented at Professional Meetings:

Danehower, D. A. A rapid method for the analysis of sucrose esters. American Chemical Society N. C. Central Section Meeting in Minature. Raleigh, N. C. April 20, 1985.

Danehower, D. A., R. C. Long, and W. W. Weeks. Influence of genotype, ontogeny, and curing of cis-abienol levels. Tobacco Chemists' Research Conference. Montreal, Canada. October 2-5, 1985.

Schell, L. P., J. R. Anderson, D. A. Danehower, and R. P. Patterson. The Relationship of adenylate levels in corn embryos to field emergence and vigor of selected corn varieties. A.S.A. National Meeting. Chicago, Ill. December 1-6, 1985.

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VIII. Graduate Student Theses Completed: None

IX. Acknowledgements:

Appreciation is expressed to the N. C. Tobacco Foundation for their generous financial support. Thanks is also extended to Professors W. W. Weeks, R. C. Long, E. A. Wernsman, and others whose conversations and discussions provide a constant stimulus to this project.

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Title: NC 03837 - Chemical Evaluation of Volatile Compounds From Tobaccos That Are Genetically Controlled for Alkaloids

Project Leader: Willard W. Weeks

I. Summary of Research

A. The purpose of this research is to determine the relationship of volatile compounds and pyridine alkaloids in tobaccos that genetically control the synthesis of nicotine.

B. To determine the effect of management upon volatiles in flue-cured tobaccos with different potentials for nicotine synthesis.

Volatiles From Varieties with Specific Genotypes that Regulate Alkaloids

Commercial cigarettes are a blend of tobacco types and flue-cured tobaccos make up a major part of most blends. Nicotine is the major constituent responsible for tobacco consumption and for this reason the inheritance of nicotine has been thoroughly studied. The genetic constitution of tobacco varieties is the basis for its chemical potential. Management, weather, and curing may alter growth and thus may be the limiting factor but ideally, all parameters optimum the genetical constitution of a variety is the dominate factor in syntehsis and accumulation of chemical constituents.

Legg and Collins in 1971 identified four true breeding genotypes in burley tobacco labelled aabb, aaBB, AAbb and AABB. The average levels of alkaloids of these genotypes were 0.3, 118, 310 and 4.0% respectively. The same genotypes have been well established in flue-cured tobacco as well. Dr. J. F. Chaplin has developed three flue-cured varieties Coker 139, NC 95 and SC 58, with these genotypes. With the exception of these genomes for regulation of alkaloids these genotypes are comparable to the parent variety. However, the order of alkaloid synthesis and concentration of the three varieties are SC 58> NC 95 > Coker 139.

This study was initiated to determine the association of tobacco volatiles with total alkaloids from these three flue-cured varieties and if possible determine linkage with alkaloid and volatile precursors. A split-plot design with three varieties, four genotypes, two stalk positions and two replications was conducted at Oxford Research Station in 1983 and 1984.

Analyses of tobacco volatiles were determined by capillary gas chromatography from steam distillation of ten grams of lamina taken from each genotype. The volatile profiles from each sample contained many compounds varying tremendously in concentration from a fraction of PPM to several PPM each. Identification of the many peaks indicates involvement of many metabolic processes in synthesis of these compounds and differences in the profiles indicate some genetic differences.

Instead of comparing every individual compound between the chromatographic profiles, the profiles were divided into five groups each. The discretion for grouping compounds into a specific group depended upon retention time, polarity, and molecular structure. The different groups also contained compounds

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derived from pigments, lignin, cell membranes and from the surface of the leaf.

The data in the table exhibits quantitative results from the cured leaf of the second priming. At this time, it is our hypothesis due to other existing data that the groups with the higher concentrations are the most flavorful tobaccos. This is true for alkaloids from the three varieties SC 68> NC 95> Coker 139. Statistical differences between varieties were found for each genotype and there was a trend for genotype AABB to be higher in each group in Coker 139 and NC 95; however, this was not the case for SC 58. The three varieties do not demonstrate the same pattern for volatiles that are obtained for alkaloids. There are other data to be obtained before conclusive evidence is obtained.

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Table of Volatiles
PPM/gm of cured tobacco

	Coker 139	NC 95	SC 58		$\bar{x}$
		AABB			
Gp 1	52.15	65.8	61.87		60.05
2	30.13	33.99	20.12		28.08
3	65.72	62.54	76.98		68.41
4	38.24	60.03	62.69		53.65
5	111.70	113.40	151.80		125.63
	Σ298.29	335.76	373.46	Σx̄	335.82
		AAbb			
1	52.9	76.49	63.94		64.44
2	26.23	34.91	43.98		35.06
3.	43.80	47.33	74.69		55.03
4.	56.75	56.45	75.58		62.98
5.	89.05	84.38	106.97		66.80
	Σ268.83	299.56	365.16	Σx̄	284.31
		aaBB			
1	47.5	60.11	84.37		63.99
2	32.35	53.51	52.69		46.18
3	44.58	52.43	69.66		55.55
4	43.75	52.66	54.40		50.27
5	109.23	105.58	156.22		144.65
	Σ277.41	324.29	417.34	Σx̄	360.64
		aabb			
1	43.05	60.78	72.40		58.74
2	21.82	21.65	24.82		22.76
3	44.58	49.03	69.66		54.42
4	25.02	36.15	25.05		28.74
5	64.47	76.78	89.33		76.86
	Σ198.94	244.39	281.26	Σx̄	241.52
Σ	1,043.47	1,204.00	1,437.22		
$\bar{x}$	260.86	301.00	359.30		

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Volatiles and Varietal Management

Tobacco quality is a broad term used in many ways but to most, quality is associated with desirability. Good tobacco is grown, not made, and this requires selection of a desirable variety, proper fertilization, sucker control and harvesting ripe tobacco and satisfactorily curing. Selection of a specific variety may depend upon ease of handling, yield and disease resistance.

An experiment was conducted at Oxford during the 1984 season to test the effect of three levels of nitrogen 40, 55 and 70 lbs per acre and Maleic Hydrazide (MH) recommended rate, and no MH on Speights G-28 and Coker 347. These two varieties differ in their performance and yield. Coker 347 is a high yielding, high alkaloid, slow maturing variety and G-28 is a lower alkaloid, lower yielding, but an easier handling and curing variety.

The treatments imposed upon the tobacco were variables that would positively influence yield, chemistry, ripening and curing of the tobacco. Increased levels of applied nitrogen increases alkaloid levels and yield, but impairs ripening. Maleic Hydrazide prevents development of lateral shoots and MH has been documented as influencing yield and chemistry of tobacco. The data for volatiles and total alkaloids are presented in the table. The volatiles are presented as groups and the discretion used for selection of groups was previously discussed. Statistical analyses of the data indicated a significant difference in alkaloids and volatile between varieties, nitrogen and MH. Significant interactions were also obtained between nitrogen and varieties. Higher levels of volatiles were obtained from lower applications of nitrogen in both varieties with lower levels of nicotine. This was very likely related to the maturity of the tobacco from these plots.

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Volatiles From Flue-Cured Varieties
PPM: Coker 347 x Speight G-28

	Coker 347		70 #N	G-28	
	MH	NMH		MH	NMH
1	13.05	13.55		16.12	15.72
2	63.11	58.16		62.91	53.14
3	19.11	16.30		15.95	16.93
4	124.93	97.93		120.60	111.31
5	209.79	171.70		161.95	130.35
	416.99	357.64		377.53	327.45

	Coker 347		55 #N	G-28	
	MH	NMH		MH	NMH
1	16.38	18.76		13.96	15.24
2	64.34	61.85		61.95	50.48
3	18.09	18.54		16.45	18.36
4	94.52	82.81		125.1	98.18
5	215.47	203.18		175.9	171.27
	408.80	385.18		393.36	353.53

	Coker 347		40 #N	G-28	
	MH	NMH		MH	NMH
1	16.69	14.89		15.24	16.34
2	77.23	73.83		68.91	67.18
3	16.58	16.82		16.44	17.13
4	137.55	113.62		172.35	154.00
5	235,66	204.03		203.29	219.86
	483.71	423.19		476.23	474.51

Alkaloids As % Nicotine From Coker 347 and G-28

	70 #N		
MH	NMH	MH	NMH
3.58	3.57	2.46	2.52
	55 #N		
3.88	3.08	2.48	2.25
	40 #N		
2.77	2.65	2.07	2.08

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IV. Publications:

Weeks, W. W. 1985. Chemistry of tobacco constituents influencing flavor and aroma. Rec. Adv. in Tob. Sci. 11:175-299.

Chang, K. W., Weeks, W. W., and Weybrew, J. A. 1985. Changes in the surface chemistry of tobacco leaves during curing with particular emphasis on trichomes. Tob. Sci. 29:122-127.

Weeks, W. W. 1985. Carotenoids: A source of flavor and aroma. Proceedings of the Symposium of Biological Source of Aroma; by invitation from American Chemical Society. (In Press)

Weeks, W. W., and Seltmann, H. 1985. Effects of sucker control on volatile compounds in flue-cured tobacco. Journal of Ag. Chem. (Accepted).

VII. Papers Presented at Professional Meetings:

Weeks, W. W. 1985. Carotenoids: A Source of Flavor and Aroma. American Chemical Society Meeting, Sept. 8-10, 1985. Chicago, IL.

Weeks, W. W. 1985. Chemistry of Tobacco Constituents Influencing Flavor and Aroma. 39th Tobacco Chemists' Research Conference. Oct. 2-5, 1985. Montreal, Canada.

Danehower, D. A., Long, R. C., and Weeks, W. W. 1985. Influence of Genotype, Ontogeny, and Curing on Cis-Abienol Levels. Oct. 2-5, 1985. Montreal, Canada.

IX. Acknowledgements:

Appreciation is expressed for the cooperation and assistance of Drs. J. F. Chaplin and Gordon S. Miner with this research project.

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Title: NC 05149 - Analytical Methodologies Required for Chemical Analyses in Experimental Tobacco Studies

Project Leader: W. W. Weeks

I. Summary of Research:

This project has the following objectives:

A. Provide efficient service of analytical data for experimental tobacco.

B. Develop procedures for chemical analyses when necessary to the total program.

The tobacco analytical service laboratory has completed the analyses of 11,000 samples from the 85 crop for 18 project leaders. The number of samples from the 85 crop was considerably less than submitted in previous years. The chemistry of this year's crop was a little unusual in that very high reducing sugars were obtained from several locations and alkaloids from the same material were low but not unduly low when compared to the high reducing sugars from the same tobaccos.

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Title: Burley Tobacco On-Farm Tests

Project Leaders: R. L. Davis, D. S. Whitley, D. J. Bolden

I. Summary of Research:

This project has the following objectives:

A. To test rates, timing, sequential applications, and combinations of all labeled sucker control chemicals on burley tobacco.

B. To evaluate the performance of available burley varieties and hybrids under the varying conditions that occur in the mountains of western North Carolina.

C. To evaluate the effects of supplemental heat in curing burley tobacco.

D. Summary of results obtained with burley herbicides are given in the Weeds Science section of the report.

Burley Tobacco On-Farm Test Results 1985

Overall, growing conditions were good during the 1985 season. Dry weather prevailed during the early part of the season. Growers that failed to water plant beds had thin stands and late plants. Plant bed fertilizer injury was prevalent in many of the counties. Dry weather continued through transplanting and for some time afterward.

Late rainfall was sufficient to produce a heavy crop of good quality. Curing conditions were generally good and less variegated or "K" tobacco was cured than in the previous several years. An early frost damaged part of the crop, especially in the northern counties.

Price support was lowered to $148.80/cwt for the 1985 sales. State average sales for the season were about $156.52/cwt. All values in this report are based on 1985 advance prices by grades.

Sucker Control

Tobacco growth was good over the area where tests were located and sucker pressure was moderate to very heavy. The lighter weights recorded at some sites were the result of harvesting somewhat early.

Several companies provided sucker control chemicals for use in these tests. All of the various forms, different concentrations, and different rates could not be fitted into a standard sized field test. Consequently, three sets of chemicals were used and labeled as Codes 1, 2, or 3. The codes and treatments are given in the accompanying tables. Also, special tests were conducted for CIBA-Geigy (Prime +), Buckeye Cellulose (Off Shoot M

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and Pittsburgh Industries, Inc. (Budnip). Treatments for these tests are presented with the tables of data.

The normal time for harvesting burley tobacco in the area will range from 21 to 28 days after topping. Sucker control becomes more difficult as harvesting time is extended. Most of these tests were harvested within the normal period but one test in the Code 2 summary stood for six weeks after topping and control was beginning to break down. Overall, sucker control was generally good.

The tank mixes of Prime Plus and contacts or systemics resulted in satisfactory sucker control. We have not been able to completely eliminate skips with contact chemicals with the hand boom used in these tests. The half rate of Prime Plus and RMH-30 (Code 2) was beginning to break down at the Macon County location as the test stood for more than 40 days and sucker pressure was heavy.

The two applications of Off Shoot T resulted in 75-85% control at all locations which is normal. Some skips usually occur with contacts and contacts alone will usually give satisfactory control for a period of about 18 to 25 days after topping. Contacts are best used as a preliminary treatment applied at the button stage followed by the application of a systemic at topping about a week later (Treatment 7, all 3 codes). This procedure will result in near total control of both pre- and post-topping suckers and will last up to six weeks after topping even under conditions of heavy sucker pressure. A contact followed by FST-7 (Treatment 5) will give similar results.

A single application of a systemic (RMH-30, Off Shoot M, Fair 2) as in Treatment 4 gave excellent control. A single application will usually last up to four weeks before control begins to break. Seasonal conditions will sometimes shorten or lengthen this control period by a small margin.

Prime + gave excellent sucker control. It will last until frost in this area. It is a contact-systemic and must be applied similar to contacts so the spray will run down the stalk and touch each sucker bud. A missed sucker will grow fast. These skips may be removed by hand about two weeks after application or they can be chopped out at harvest time. A single nozzle hand sprayer or dropline will result in fewer skips than the three-nozzle hand boom used in these tests.

The Prime + chemical has a carry over effect in the soil and may stunt small grain following the tobacco crop. FST-7 (Treatment 8) gives excellent sucker control in the mountain area. We find the 9-quart per acre rate is effective in this area (Codes 1 and 3) but the three gallon rate (Code 2) is used in most other areas.

Overall, yields were very good this year even though growth was uneven. All chemicals used generally resulted in increased yield over the not

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suckered check but the uneven growth and variability in test areas masked any differences that might have occurred among the chemicals.

Individual tests were conducted for CIBA-Geigy, Buckeye Cellulose, and Pittsburgh Industries. The treatments used accompany the tables of data and are self explanatory.

The CIBA-Geigy test was located on the C. W. Ross farm in Haywood County. The site was bottom land and had been irrigated during dry weather early in the season. The plants were big and sucker pressure was extremely heavy for burley tobacco. Harvest was delayed somewhat beyond the optimum for this crop. Leaf drop or leaf breakage - not a result of sucker control treatments - had occurred at places in the test and may have been heavy enough to cause variation in plot yield.

Sucker control was very good for all treatments. Some skips were evident with Prime Plus with both the boom and dropline (little difference between the two methods in this test). The tank mixes with Off Shoot T at the full rate and with RMH-30 at half rate were equally effective in controlling suckers.

The Pittsburgh Industries test with Bud Nip (has experimental use permit for burley) was located on the Earmel Wheeler farm in Yancey County. The tobacco crop was about two to three weeks later than is normal for the area. All treatments resulted in excellent sucker control. Sucker pressure was light since the crop was late and the interval between topping and harvest was only three weeks.

The Buckeye Cellulose test was located on the Georgia Green farm in Haywood County. This was an average crop of tobacco with moderate sucker pressure. The Off Shoot M proved equally as effective as the other forms of maleic hydrazide currently available.

Sucker Control 1985
Code 1

1. Topped, not suckered until harvest.
2. OST @ 1.5 GPA plus Prime + @ 1 GPA tank mix at button.
3. OST @ 1.5 GPA button + OST @ 1.5 GPA at topping, dropline used.
4. RMH-30 2 PGA at topping.
5. Fair 85 @ 1.5 GPA button + FST-7 @ 2 GPA at topping.
6. Prime + @ 1 GPA at topping.
7. OST @ 1.5 GPA button + Off Shoot M @ 2 GPA at topping.
8. FST-7 @ 9 quarts/acre at topping.

Sucker Control 1985
Code 2

1. Topped, not suckered until harvest.
2. RMH-30 @ 1 GPA + Prime Plus @ $\frac{1}{2}$ GPA (tank mix) at topping.

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Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

3. OST @ 1.5 GPA button (dropline) + OST @ 1.5 GPA at topping with boom.
4. Off Shoot M @ 2 GPA at topping.
5. Fair 85 @ 1.5 GPA button + FST-7 @ 2 GPA at topping.
6. Prime + @ 1 GPA at topping with boom.
7. Fair 85 @ 1.5 GPA button + RMH-30 @ 2 GPA at topping.
8. FST-7 @ 3 GPA at topping.

Sucker Control 1985
Code 3

1. Topped, not suckered until harvest.
2. Off Shoot M @ 1 GPA + Prime Plus @ ½ GPA (tank mix) at topping.
3. OST @ 1.5 GPA button (boom) + OST @ 1.5 GPA at topping (dropline).
4. Fair 2 @ 1.5 GPA at topping.
5. Fair 85 @ 1.5 GPA button + FST-7 @ 2 GPA at topping.
6. Prime + @ 1 GPA at topping.
7. OST @ 1.5 GPA button + RMH-30 @ 2 GPA at topping.
8. FST-7 @ 9 quarts/acre at topping.

Sucker Control 1985

Code 1
(Averages for 3 Tests)

Tmt	% Control	Suckers* no./plant	Green Wt. gms/pl
1	--	6.6	285
2	92	0.2	23
3	86	2.4	39
4	92	0.2	22
5	100	0.0	0
6	92	0.6	23
7	99	0.2	2
8	98	0.2	6

*Averages for 2 tests only

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Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

Code 1
(Averages for 2 Tests)

Tmt	Acre Yield	$/cwt	Acre Value
1	1832	156.75	2871
2	1913	155.04	2981
3	2015	156.00	3164
4	1990	156.23	3127
5	1945	156.37	3059
6	2054	156.35	3221
7	1945	155.67	3039
8	2006	155.03	3133

Code 2
(Averages for 3 Tests)

Tmt	% Control	Suckers* no./plant	Green Wt. gms/pl
1	--	5.5	834
2	88	2.3	140
3	79	3.0	190
4	96	2.2	50
5	97	1.8	49
6	78	1.7	171
7	99	0.7	15
8	90	2.4	103

*Averages for 2 tests only

Code 2
(Averages for 2 Tests)

Tmt	Acre Yield	$/cwt	Acre Value
1	1887	156.11	2950
2	2279	155.68	3553
3	2322	156.28	3632
4	2259	155.83	3524
5	2656	156.07	4147
6	2341	156.19	3660
7	2463	155.76	3838
8	2659	156.29	4156

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Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

Sucker Control 1985
Waldroup - Graham County
Code 3

Tmt	% Control	Suckers no/pl	Gn. Wt gms/pl	Acre Yield*	$/cwt	$/Acre
1	---	6	612	1745	159.57	2786
2	100	0	0	1918	160.25	3073
3	76	4	147	1854	159.38	2963
4	100	0	0	1732	157.63	2733
5	100	0	0	1968	159.62	3141
6	99	0.2	7	2013	160.09	3221
7	100	0	0	1718	159.55	2741
8	100	0	0	2135	160.78	3434

1st application 7/26
2nd application 8/2
Harvest 8/30
* Fusarium wilt infection in several plots

Prime + - Ciba-Geigy
Ross - Haywood County

Tmt*	% Control	Suckers no/pl	Gn. Wt gms/pl	Acre Yield	$/cwt	$/Acre
1	---	7	1568	1547	156.99	4315
2	92	0.8	132	2539	153.34	3891
3	96	0.9	63	2774	154.72	4298
4	100	0.4	3	3427	150.19	5158
5	100	0.3	2	3645	154.65	5654
6	99	0.6	18	2852	154.26	4385
7	99	1.1	21	3219	151.57	4878
8	95	0.8	74	2961	150.95	4465

1st application 7/23
2nd application 7/25
3rd application 7/29
Cleanup 8/28
* Treatments:

1. Topped, not suckered until harvest.
2. Prime + @ 1 GPA elongated button, apply two or three times with dropline as plants reach elongated button stage.
3. Prime + @ 1 GPA at topping with boom.
4. RMH-30 @ 2 GPA at topping.
5. OST @ 1.5 GPA button + RMH-30 @ 2 GPA at topping.
6. OST @ 1.5 GPA plus Prime + @ 1 GPA tank mix at topping.
7. RMH-30 @ 1 GPA plus Prime + @ ½ GPA tank mix at topping.
8. Prime + @ 1 GPA at topping with dropline.

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Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

Off Shoot M - Buckeye Cellulose
Green - Haywood County

Tmt*	% Control	Suckers no/pl	Gn. Wt. gms/pl	Acre yield	$/cwt	$/Acre
1	--	7.0	406	2144	146.07	3140
2	97	0.5	11	2430	146.03	3554
3	98	0.7	10	2153	141.04	3037
4	97	0.8	14	2271	148.75	3381
5	97	1.1	11	2180	145.39	3161
6	97	0.8	13	2172	148.99	3231
7	97	1.0	14	2353	145.67	3429
8	83	1.4	68	2262	150.14	3396

1st application 8/12, second application 8/14
*Treatments:

1. Topped, not suckered until harvest.
2. OST @ 1.5 GPA button + OSM @ 2 GPA at topping.
3. OST @ 1.5 GPA button + RMH-30 @ 2 GPA at topping.
4. Fair 85 @ 1.5 GPA button + Fair + @ 2 GPA at topping.
5. Off Shoot M @ 2 GPA at topping.
6. Royal MH-30 @ 2 GPA at topping.
7. Fair + @ 2 GPA at topping.
8. Prime + @ 1 GPA at topping.

Bud Nip - Pittsburgh Industries, Inc.
Wheeler - Yancey County

Tmt*	% Control	Suckers no/pl	Gn. Wt. gms/pl	Acre Yield	$/cwt	$/Acre
1	--	7.3	107	2557	155.83	3982
2	96	0.5	4	2548	154.54	3938
3	97	0.4	3	2684	154.95	4157
4	95	0.7	5	2652	155.38	4122
5	99	0.1	1	2820	155.62	4387
6	93	0.9	8	2493	154.33	3853
7	96	0.4	4	2448	156.02	3819
8	97	0.1	3	2684	154.71	4151

1st tmt applied 8/28
2nd 9/4, harvested on 9/24

*Treatments:

1. Topped, not suckered until harvest.
2. Bud Nip, 1 GPA at topping.
3. OST @ 2 GPA button + Bud Nip @ 1 GPA at topping.
4. RMH-30 @ 2 GPA at topping.
5. OST @ 1.5 GPA button + RMH-30 @ 2 GPA at topping.
6. Prime + @ 1 GPA at topping.
7. FST-7 @ 9 Quarts/Acre at topping.
8. OST 3% + Bud Nip 1% tank mix at topping.

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Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

Burley On-Farm Variety Tests

The growing season was dry during and for an extended period after transplanting but rains came in time to produce moderate to heavy yields at most test sites. An early frost caused minor damage at some locations. The curing season was favorable as a whole. The variety tests are representative of a very good crop for the western North Carolina area.

Kentucky 14 and Virginia 509 are considered as standards in these tests. Kentucky 14 is still the most popular burley variety in North Carolina. It is high yielding, late maturing, leaf spot tolerant, and well adapted to the area. Virginia 509 still seems to be the best of the currently available straight line black shank resistant varieties.

The test had four new entries this year. These were Rickard's R-7-11, Clay's 501 and 102, and Greeneville 136 (to be released as Tennessee 86). The Rickard and Clay entries are hybrids that do not have a published pedigree.

The Rickard R-7-11 was the overall top yielding entry in the test. It is a large plant, late maturing, and black shank susceptible, but appears to be tolerant to leaf spots. The Clays entries have resistance to both races of black shank and appear to have potential for high yields. However, they appear to be sensitive to leaf spots (weather fleck and virus combinations) which were severe at some locations this year. The Greeneville 136 (Tn 86) will be eligible for release later this year if it favorably passes test requirements. It has resistance to black shank, black root rot, and wildfire. It is the first burley variety to have resistance to tobacco vein mottle virus, tobacco etch virus, and potato virus y. It is, however, susceptible to tobacco mosaic. It is also the first black shank resistant variety with potential for high yield. It ranked second in these tests being slightly lower than Rickard's R-7-11. It is late maturing but otherwise appears to be very well adapted to the conditions in western North Carolina.

Other high yielding entries were Bur 21 x Ky 10, Ky 14 x L8, and Bur 21 x Ky 14. The Ky 14 x L8 is sensitive to the leaf spot complex and yields were reduced at some locations as a result. Kentucky 17 has been a moderate yielding variety in western North Carolina.

Values were based on 1985 support prices by grades. The slight differences in prices per pound obtained are not considered to be varietal differences but rather a result of differences in curing locations within the barns where plots were hung with some spots being more favorable than others. Burley breeders in this country have not detected differences in selling price among current varieties over the past several years.

Results from seven locations for acre value, selling price, and acre yield are given in the table.

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Burley Varieties 1985
Averages for 7 Locations

	Variety	Acre Yield	$/cwt*	$/Acre
1.	Kentucky 14	2867	155.25	4454
2.	Virginia 509	2654	154.85	4110
3.	21 x 10	2926	155.41	4552
4.	R 7-11	3028	155.77	4722
5.	C 501	2559	156.44	4007
6.	C 102	2772	154.55	4288
7.	14 x L8	2786	154.60	4311
8.	Gr 136	2974	156.14	4645
9.	21 x 14	2881	155.71	4486
10.	Kentucky 17	2526	153.78	3894

* 1985 advance prices

Curing With Supplemental Heat

Although the curing season was favorable over most of the western North Carolina burley area in 1985, more use of supplemental heat was required at the two curing locations (Madison and Ashe Counties) than has been used for the past several seasons. Rainfall was scarce, but fogs, cloudy weather, and continued high humidity required the use of heat at several different times. Results indicate a substantial increase in yield, selling price, and acre value for the tobacco cured with supplemental heat. Houseburn, which is actually a partial rotting of the curing tobacco, reduces weight drastically. The associated poorer quality results in lowered selling price and reduced acre value.

The objective in using supplemental heat with burley is not to flue cure the tobacco, but rather to raise the temperature and thus lower the humidity just enough to prevent the proliferation of the organisms (bacteria, fungi, yeasts) that cause houseburn. This can usually be accomplished by merely raising the temperature 6-8 F. If higher temperature occurs, undesirable colors can be set in the leaf, thereby causing lowered quality.

Curing With Supplemental Heat 1985
2 Locations

Treatment	Acre Yield	$/cwt	$/Acre
No Heat	2489	151.81	3759
Heat	3009	156.55	4710

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Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

Title: NC 3835 Explanation of Size Distribution of Farms, and

Explanation of Size and Structure in Tobacco Farming (a Tobacco Foundation project)

Project Leader: Daniel A. Sumner

I. Summary of Research:

These two projects are closely related. Collection and analysis of economic data at the county level is proceeding. A survey of flue-cured tobacco quota lease and sales prices across North Carolina was conducted. These data are being linked to our other information to study supply conditions.

Aggregate data was used to analyze the effects of potential changes in programs to changes in structure in tobacco and other industries. There is little reason to expect even the elimination of commodity programs to significantly change the established trends in consolidation.

In a paper on taxes and investment in agriculture, we found weak evidence of the often discussed tax-induced investments in farming. We suggest there is reason for skepticism that changes in the federal income tax code are a dominant factor in explaining patterns of investment in U.S. agriculture. We are continuing this work with case studies, including investments in tobacco. Analysis of the effects of potential tobacco program and other commodity changes appeared in a number of publications. This work is part of a continuing effort over the last few years.

II. Graduate Students: Arthur Sparrow, Parrie Henderson.

IV. Publications:

Sumner, Daniel A. 1985. Farm programs and structural issues, in Bruce Gardner, ed., U.S. Agricultural Policy: The 1985 Farm Legislation. Washington, D.C.: American Enterprise Institute, pp. 283-320.

Wohlgenant, Michael K. and Daniel A. Sumner. 1985. Effects of an increase in the federal excise tax on cigarettes. International Migration Review 19:235-42.

Sumner, Daniel A. and D. Arthur Sparrow. 1985. Size distributions of tobacco farms and enterprises, in Farrell Delman, ed., Current Issues in Tobacco Economics, economics papers presented at the Tobacco Workers Conference. New York: Tobacco Merchants Association of the U.S., pp. 69-82.

Expected impacts of agricultural legislation: comparison of the administration's proposed food and agriculture program with an extension of the Agriculture and Food Act of 1981 as amended. Report No. 104, Council for Agricultural Sciences and Technology, Ames, Iowa, May 1985, as a member of a writing group of a dozen members.

2000270309

Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

V. Manuscripts Accepted for Publication:

Sumner, Daniel A. and Julian M. Alston. Forthcoming 1986. Structural consequences of commodity programs. AEI Occasional Paper, American Enterprise Institute Project on Agricultural Policy.

Peace, Robert L. and Daniel A. Sumner. Forthcoming 1986. Income taxes and farm sector investment: the reasoning and some evidence. The Journal of Agricultural Taxation and Law.

2000270310

Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

Title: NC 13943 The Effects of Farm Programs on Prices, Quantities and Incomes of Field Crop Producers and Consumers

Project Leaders: Randal R. Rucker and Daniel A. Sumner

I. Summary of Research:

This new project involves continuing research on effects of policy on tobacco and other commodities.

An analysis of the future trends in the comparative position of southern commodities resulted in the conclusion that contrary to some assertions, tobacco would have an expanding role in southern agriculture if programs were removed. This follows logically as a result of low basic costs for production of high quality tobacco.

Research on tobacco demand has begun to examine the interaction of health information and other demand shifters with tobacco price affecting the patterns of substitution of imported tobacco and other inputs for U.S. tobacco in the U.S. cigarette industry.

Work is proceeding on the estimation of market supply function parameters from data on quotas and lease rates. This approach allows econometric determination of the underlying producer supply function even though market price and quantity observation do not lie on the marginal cost curve.

II. Graduate Student: Ruey-Er Chang

IV. Publications:

Sumner, Daniel A. 1985. An econometric analysis of the interstate demand for cigarettes, including the demand to smuggle, in Farrell Delman, ed., Current Issues in Tobacco Economics, economics papers given at the Tobacco Workers Conference. New York: Tobacco Merchants Association of the U.S., pp. 109-20.

Sumner, Daniel A. and Julian M. Alston. 1985. The Removal of Price Supports and Supply Controls for Tobacco: An Economic Analysis of the Impact. Washington, D.C.: Food and Agriculture Committee of the National Planning Association.

V. Manuscripts Accepted for Publication:

Sumner, Daniel A. and Julian M. Alston. Forthcoming 1986. The effects of the tobacco program in the U.S.: an analysis of deregulation. AEI Occasional Paper, American Enterprise Institute Project on Agricultural Policy.

Sumner, Daniel A. Forthcoming 1986. The competitive position of southern commodities. Invited paper presented at the annual meeting of the Southern Agricultural Economics Association and to appear in the Southern Journal of Agricultural Economics 18 (July 1986).

2000270311

Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

VII. Papers Presented at Professional Meetings:

Sumner, Daniel A. and Julian M. Alston. 1985. The demand for U.S. tobacco: econometric estimation and interpretation. Presented at the annual meetings of the American Agricultural Economics Association; abstract to be published in the American Journal of Agricultural Economics 67 (December 1985).

2000270312

Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

Title: The Effects of Farm Programs on Farm Size and Structure in the Tobacco and Peanut Industries (USDA Cooperative Agreement)

Project Leaders: Daniel A. Sumner and Steven Margolis

I. Summary of Research:

This is a new project that provides additional funding for our work on structural issues in tobacco.

We have begun to put county-level data from the 1969 through 1982 Censuses of Agriculture in usable form. For counties that produce tobacco, we will take average characteristics of farms and farmers from the census tapes and link them to data on nonfarm alternatives and to more detailed data on tobacco quota changes and lease rates. This will allow us to estimate the impact of tobacco program adjustment on structural variables at the county level.

A conceptual analysis of specific marketing institutions has begun with an examination of tie-in sales between producers and agricultural product handlers and processors. Our model focuses on using a tied sale to assure contractual reliability. The initial application of the model has been to peanut contracts rather than tobacco, but it has implications for the evolution of tobacco marketing under alternative regulations.

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Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

Title: Biology, Ecology and Management of Insects in Tobacco: NC03893

Project Leader: Emmett P. Lampert

I. Summary of Research:

A. Evaluation of Insecticides for Control of Insect Pests

Experiments were conducted at the Border Belt Tobacco Research Station, Central Crops Research Station, and the Upper Piedmont Research Station to evaluate the efficacy of various soil-applied, transplant water and foliar-applied insecticides against insects in flue-cured tobacco. Soil insecticide tests were conducted at the Border Belt Tobacco Research Station and the Upper Piedmont Research Station. At the Border Belt Tobacco Research Station, a 12-treatment test was conducted to determine efficacy against tobacco wireworms, tobacco flea beetles, aphids and tobacco hornworms. Effects on yield and quality were also determined. At the Upper Piedmont Research Station, an 11-treatment test was conducted to examine control of wireworms and flea beetles using transplant water treatments and preplant incorporated materials. This test was terminated on June 27 due to poor tobacco survival and growth.

At the Central Crops Research Station, three tests of 10 treatments were conducted to examine the efficacy of foliar insecticide against tobacco budworms, tobacco flea beetles, tobacco hornworms and green peach aphids. In addition, three tests of 8, 10, and 14 treatments were conducted to examine phytotoxicity of candidate insecticides and tank mixes of registered pesticides. Tobacco samples were also collected for residue analysis and smoke flavor evaluation. Due to the bulk of the reporting of the specific experiments, the reader is referred to "Chemical Tests in Flue-Cured Tobacco in 1985" for further information.

B. The Interaction Between Certain Plant Characteristics, Aphid Honeydew Production, and Sooty Mold Growth on the Quality of Flue-Cured Tobacco

Research supported by the R. J. Reynolds Postdoctoral Fellowship Program was completed in 1985. Several of the projects have been reported in the past two annual reports. A final report is available to anyone wanting the information. I will summarize the last test conducted concerning the effects of the tobacco age on honeydew production by, and the life history of the green peach aphid.

Our aphid culture was started with feral GPA collected on 15 August 1984 on McNair 944 tobacco at the Central Crops Research Station. The experiment was conducted three times - 3,

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6, and 7 months after aphids were collected from the field. Each experiment consisted of three plant age classes - 5-, 10-, or 15-leaf plants - with 5 aphids in each plant age class in each experiment (15 aphids per treatment total). A single aphid was confined to the first palm-sized leaf at the top of each plant in a plastic cage. Aphid survival, fecundity and honeydew production were monitored daily.

All experiments were arranged in completely randomized designs. Data were analyzed with analyses of variance. Sums of squares (SS) for interaction (experiments 1-3 x 3 plant age classes) were compared to error SS to determine whether treatment differences were consistent among the three experiments. The interaction SS was then used as the denominator in F-tests to determine whether there were differences between results of the three experiments or between the results of the three plant age classes.

Average daily temperatures were 23°, 25°, and 24° in the three experiments.

Varying plant age did not affect the number of drops produced per aphid during its lifetime (Table 1); $F_{2,4} = 0.56$, $P > F = 0.61$), volume of honeydew drops (Table 2; $F_{2,4} = 0.23$, $P > F = 0.80$), or total volume of honeydew produced (Table 3; $F_{2,4} = 0.94$, $P > F = 0.46$). There was a general tendency toward a decrease in honeydew production with increasing plant age.

Plant age also did not affect longevity (Table 4; $F_{2,4} = 0.79$, $P > F = 0.51$), number of days until reproduction began (Table 5; $F_{2,4} = 0.59$, $P > F = 0.60$), total number of nymphs produced (Table 6; $F_{2,4} = 1.27$, $P > F = 0.37$), number of nymphs produced per day of adult life (Table 7; $F_{2,4} = 0.38$, $P > F = 0.71$), Ro (mean $\pm$ SE = 30.6 $\pm$ 19.2, 26.3, 8.4, and 18.5 $\pm$ 8.1 for 5-, 10-, and 15-leaf plants, respectively; $F_{2,6} = 0.68$, $P > F = 0.54$), or number of nymphs surviving to the adult stage (mean $\pm$ SE = 4.0 $\pm$ 1.7, 4.7 $\pm$ 0.6, and 4.0 $\pm$ 1.7 nymphs for 5-, 10-, and 15-leaf plants, respectively; $F_{2,6} = 0.21$, $P > F = 0.82$). Again there was a general trend toward plants being less suitable for aphids as plant age increased.

In conclusion, plant age did not significantly affect honeydew production or life history parameters of GPA feeding on flue-cured tobacco.

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Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

C. Biology of the Tobacco Flea Beetle and its Effects on Yield

In order to study the biology of an insect in the field and determine what effects it has on yield and quality, it is important to determine methods for estimating the abundance of the pest. The tobacco flea beetle (TFB) is an important pest of tobacco, yet little is known on the biology of the underground stages of this pest. Therefore, studies were undertaken to determine: (1) the seasonal abundance of the soil-inhabiting life stages, larvae and pupae, of the TFB, (2) accurate methods of sampling for these soil-inhabiting life stages of the TFB, (3) seasonal abundance of emerging adult TFBs, and (4) fast and accurate methods of sampling TFB adult emergence.

Experiments were conducted at the Central Crops Research Station during 1984 and 1985. In 1985, weekly soil cores, 10 and 20 cm diam, were taken and larvae extracted using Berlese funnels. Additional 10 cm cores were taken and examined for pupae. Pupae were extracted by washing the samples through a series of sieves. After the soil had been removed, the remains of the sieves were immersed in a 20% hydrated magnesium sulfate solution. Larvae and pupae floated in this solution and were collected and preserved. Adult emergence was monitored using an emergence trap constructed of an inverted #10 institutional food can fitted with a 20 dram collecting vial (soil surface equals 177 cm^2). Emergence traps were monitored once per week in 1984 and at least twice per week in 1985.

The seasonal abundance of emerging adults, pupae and larvae are summarized in Figure 1. In 1984 the tobacco was transplanted on May 4, and in 1985, on May 1. At least two generations of larvae and pupae were observed. Due to the low densities, additional generations were difficult to determine. In both years, four generations of emerging adults were observed. This tobacco field was not destroyed after the last harvest, which allowed build-up of additional late-season generations.

Using the means and variances from the 10 and 20 cm core data, the relationship between the mean and variance (Taylor 1961) was determined to be:

$$\text{Variance} = 5.31\ \text{mean}^{1.723}$$

for 10 cm cores, and

$$\text{Variance} = 5.47\ \text{mean}^{1.715}$$

for 20 cm cores. These relationships were not significantly different and were pooled to obtain the following relationship:

$$\text{Variance} = 5.34\ \text{mean}^{1.717}$$

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This relationship was then used to reconstruct variances and simulate the optimum sample sizes required for a given mean in the following equation (Karandinos 1976):

$$n = \frac{s^2}{(C\bar{X})^2}$$

where C = is the desired level of precision calculated by standard error/mean. This simulation was performed for pooled 10 and 20 cm cores with C values of 0.2, 0.3, and 0.5. The results are summarized in Figure 2. Looking at these results, it is apparent that an extremely large sample size is required to obtain precise estimates of larval density. Further, this requires access to a large number of Berlese funnels, which require a lot of space. Therefore, direct larval sampling may not be justified for certain types of tests, and indirect methods should be considered.

A similar analysis was conducted on the pupal core data. The following relationship between variance and mean was obtained:

$$\text{Variance} = 1.37\ \text{mean}^{1.185}$$

Once again the optimum sample size simulation was performed and the results are summarized in Figure 3. This resulted in a much more manageable sample size and could be used to directly sample pupae or indirectly sample TFB larvae.

The similar analyses on adult emergence trap data resulted in the following relationship between variance and means:

$$\text{Variance} = 2.30\ \text{mean}^{1.288}$$

The optimum sample numbers required for given levels of precision was simulated and is summarized in Figure 4.

Emergence traps are inexpensive to construct and relatively easy to monitor. Therefore, the sample sizes recommended for given levels of precision are not unmanageable and could easily be used to monitor adult emergence directly or indirectly to estimate larval density.

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Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

References Cited

Karandinos, M. G. 1976. Optimum sample size and comments on some published formulae. Bull. Entomol. Soc. Am. 22: 417-421.

Taylor, L. R. 1961. Aggregation, variance, and the mean. Nature (London) 189: 732-735.

D. Investigation of the Relationship Between TEV Epidemiology and the Biology of Myzus persicae and other TEV Vectoring Aphids

Aphids are responsible for the spread of 10 different virus diseases of tobacco in North Carolina tobacco etch virus (TEV) alone caused an estimated $679,129 loss to North Carolina tobacco production (flue-cured plus burley) in 1984 (Main and Nusser 1985). Because this virus is primarily spread by aphids, an understanding of the vector biology relative to the disease cycle is imperitive if we are to try to control the disease. The objectives of this study were to: (1) determine the extent and difference between primary and secondary spread of TEV, (2) determine if virus spread could be controlled by controlling colonizing aphids, and (3) determine if potentially viruliferous aphids are attracted or repelled by virus-infected plants in the field.

This study was conducted on an excess allotment of flue-cured tobacco (NC 2326) in Duplin Co., NC in 1985. Twenty 0.6 acre plots of solid planted tobacco (no 5th row middles) were established. Half of the plots were treated with pre-plant incorporated Temik @ 3 lb ai/A followed by Orthene TIS @ 0.75 lb ai/A, every two weeks post-transplant to exclude colonizing aphids. Half of the plots were also inoculated with TEV shortly after transplant to guarantee a virus source. The treatment combination consisted of (1) inoculated, no insecticide, (2) non-inoculated, no insecticide, (3) inoculated, insecticide treated, and (4) non-inoculated, insecticide treated. Nine (11 cm x 11 cm) clear bottom aphid alighting traps were placed in each plot. On a weekly basis, each plant in the field was evaluated for aphid infestation and TEV infection. Aphids from traps were also collected weekly and preserved for future identification.

Large quantities of naturally occurring TEV were present in all plots. Primary and secondary spread were best evaluated early in the season. Figure 5 shows virus progression for the first five weeks of both an insecticide and a non-insecticide treated plot. Secondary spread (S) of virus was minimal in all plots compared to primary spread (P).

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Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

No significant differences in total seasonal infection were found between treatments. A slight trend, however, toward less total seasonal infection in insecticide treated plots was observed.

Mean aphids per alighting trap was affected by the health status of the plant under the trap (Fig. 6). Before topping the tobacco plants, virus infected plants were more attractive than healthy plants.

In this study we found that the primary spread of TEV was much greater than secondary spread. As we would expect from this, no significant differences were found in total seasonal infection between treatments. Aphids were, however, found to be preferentially attracted to TEV infected plants before topping. This study will continue in 1986.

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II. Graduate Students:

- Committee Chairman - Ms. Randi Wilfert (Ph.D. Co-Chairman)
  Mr. Michael Duke (M.S.)
- Committee Member - 2 (Ph.D.)
- Special Students - Ms. Amy Smith, R.J. Reynolds Undergraduate Research Apprentice

III. Postdoctoral Fellows:

- Dr. James E. Throne, R.J. Reynolds Fellowship

IV. Publications:

Lampert, E. P., and D. L. Haynes. 1985. Population dynamics of the cereal leaf beetle, Oulema melanopus (Coleoptera: Chrysomelidae), at low population densities. Environ. Entomol. 14: 74-79.

Whitfield, G. H., R. I. Carruthers, E. P. Lampert, and D. L. Haynes. 1985. Spatial and temporal distribution of plant damage caused by the onion maggot (Diptera: Anthomyiidae). Environ. Entomol. 14: 262-266.

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V. Manuscripts Accepted for Publication:

Throne, J. E., and E. P. Lampert. (In press) Honeydew production by green peach aphids (Homoptera: Aphididae) in tobacco plants of varying age. Tob. Sci.

Throne, J. E., and E. P. Lampert. (In press) Age-specific honeydew production and life-history of green peach aphids (Homoptera: Aphididae) on flue-cured tobacco. Tob. Sci.

Lampert, E. P. (In press) Control of tobacco wireworms with soil and transplant water insecticides, 1985. Insect. and Acar. Tests 11.

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VI. Manuscripts in Review:

Gray, S.M., and E.P. Lampert. Seasonal abundance of aphid-borne virus vectors in flue-cured tobacco as determined by alighting and aerial interception traps. Submitted to J. Econ. Entomol., Nov. 12, 1985.

VII. Papers Presented at Professional Meetings:

Duke, M.E., and E.P. Lampert. Monitoring populations of tobacco flea beetles, Epitrix hertipennis (Melsheimer). Nat. Ent. Soc. Am. Meetings, Hollywood, FL. December 11, 1985.

Lampert, E.P. Tobacco scouting techniques. Discussion Leader, Tob. Seminar, Destin, FL. February 25, 1986.

VIII. Graduate Student Thesis Completed During Reporting Period: None

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Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

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Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

Table 1. Effects of plant age on number of honeydew drops produced by GPA feeding on flue-cured tobacco.

Experiment	Plant age (number of leaves)								
	5			10			15		
	$\bar{X}$	SE	n	$\bar{X}$	SE	n	$\bar{X}$	SE	n
1	99.5	28.5	2	128.0	61.1	5	135.0	32.0	2
2	193.2	33.0	5	212.0	14.2	4	152.4	35.1	5
3	328.4	101.4	5	241.8	60.0	5	228.0	26.2	5

Table 2. Effects of plant age on volume (µl) of honeydew drops produced by GPA feeding on flue-cured tobacco.

Experiment	Plant age (number of leaves)								
	5			10			15		
	$\bar{X}$	SE	n	$\bar{X}$	SE	n	$\bar{X}$	SE	n
1	0.027	0.007	2	0.021	0.003	5	0.026	0.007	2
2	0.023	0.002	5	0.025	0.001	4	0.018	0.002	5
3	0.028	0.002	5	0.029	0.002	5	0.028	0.004	5

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Source: https://www.industrydocuments.ucsf.edu/docs/fyjk0000

Table 3. Effects of plant age on volume (µl) of honey produced during the lifetime of GPA feeding on flue-cured tobacco.

Experiment	Plant age (number of leaves)								
	5			10			15		
	$\bar{X}$	SE	n	$\bar{X}$	SE	n	$\bar{X}$	SE	n
1	2.832	1.404	2	3.409	2.181	5	3.746	1.752	2
2	4.522	0.891	5	5.411	0.554	4	2.842	0.815	5
3	9.393	3.365	5	7.258	2.098	5	6.364	1.219	5

Table 4. Effects of plant age on longevity (days) of GPA feeding on flue-cured tobacco.

Experiment	Plant age (number of leaves)								
	5			10			15		
	$\bar{X}$	SE	n	$\bar{X}$	SE	n	$\bar{X}$	SE	n
1	10.2	2.6	5	18.2	2.8	5	10.0	4.2	5
2	16.6	0.8	5	14.0	2.8	5	14.4	1.3	5
3	22.8	1.2	5	17.2	2.4	5	15.0	1.5	5

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Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

Table 5. Effects of plant age on number of days until reproduction begins for GPA feeding on flue-cured tobacco.

Experiment	Plant age (number of leaves)								
	5			10			15		
	$\bar{X}$	SE	n	$\bar{X}$	SE	n	$\bar{X}$	SE	n
1	7.5	0.5	2	8.2	0.4	5	8.0	1.0	2
2	7.2	0.2	5	6.3	0.3	4	8.0	0.5	5
3	8.2	0.4	5	7.2	0.2	5	7.4	0.8	5

Table 6. Effects of plant age on total number of nymphs produced by GPA feeding on flue-cured tobacco.

Experiment	Plant age (number of leaves)								
	5			10			15		
	$\bar{X}$	SE	n	$\bar{X}$	SE	n	$\bar{X}$	SE	n
1	32.5	10.5	2	18.4	8.2	5	33.0	7.0	2
2	27.8	4.5	5	31.8	4.6	4	14.4	4.4	5
3	51.0	5.9	5	35.2	8.6	5	27.8	7.7	5

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Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

Table 7. Effects of plant age on number of nymphs produced per day of adult life by GPA feeding on flue-cured tobacco.

Experiment	Plant age (number of leaves)								
	5			10			15		
	$\bar{X}$	SE	n	$\bar{X}$	SE	n	$\bar{X}$	SE	n
1	3.2	0.7	2	1.5	0.4	5	2.6	0.7	2
2	2.6	0.3	5	3.1	0.5	4	1.9	0.4	5
3	3.3	0.3	5	3.3	0.3	5	3.2	0.4	5

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Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

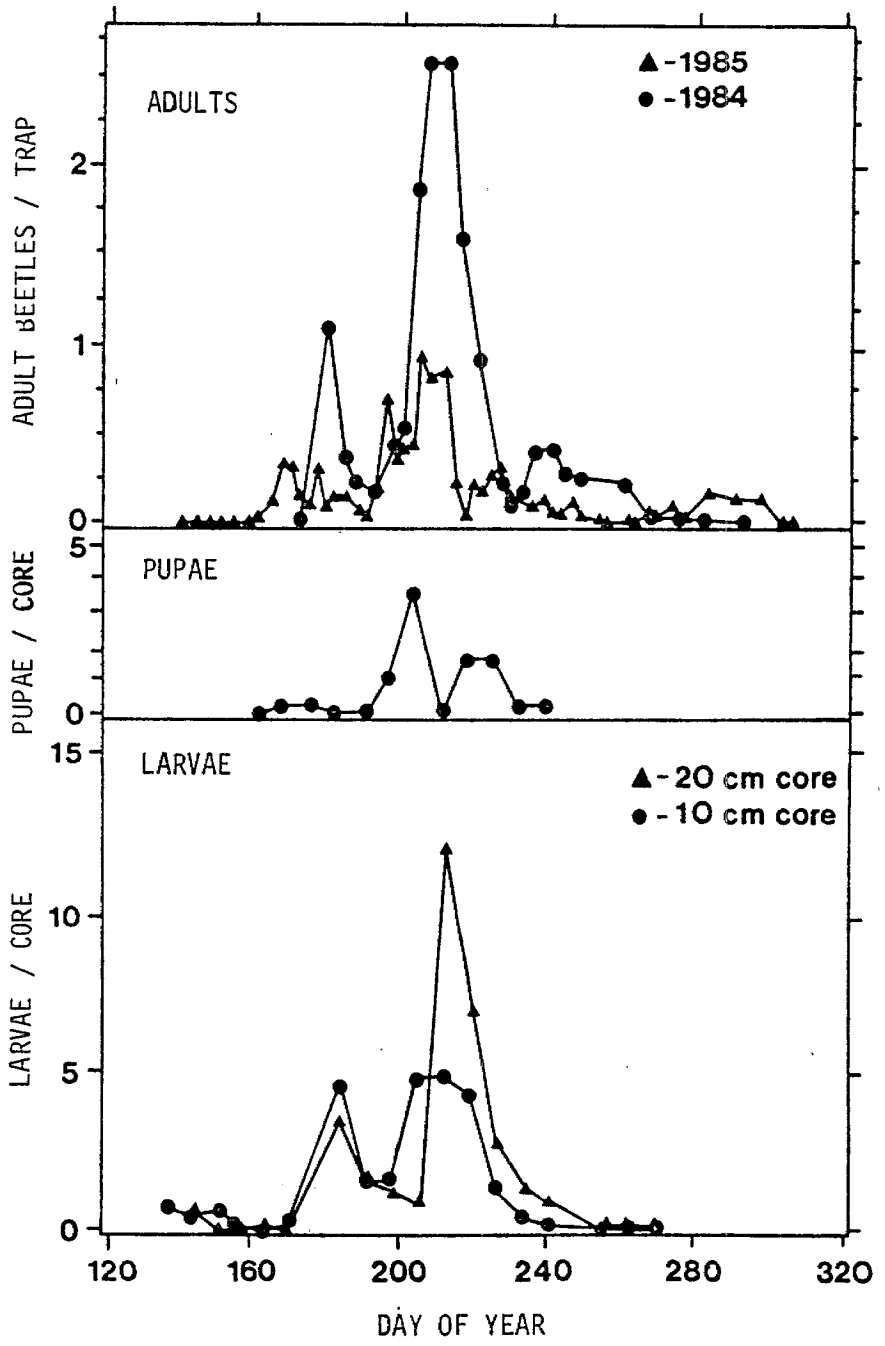

Figure 1. Phenology of tobacco flea beetles in flue-cured tobacco, Central Crops Research Station.

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Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

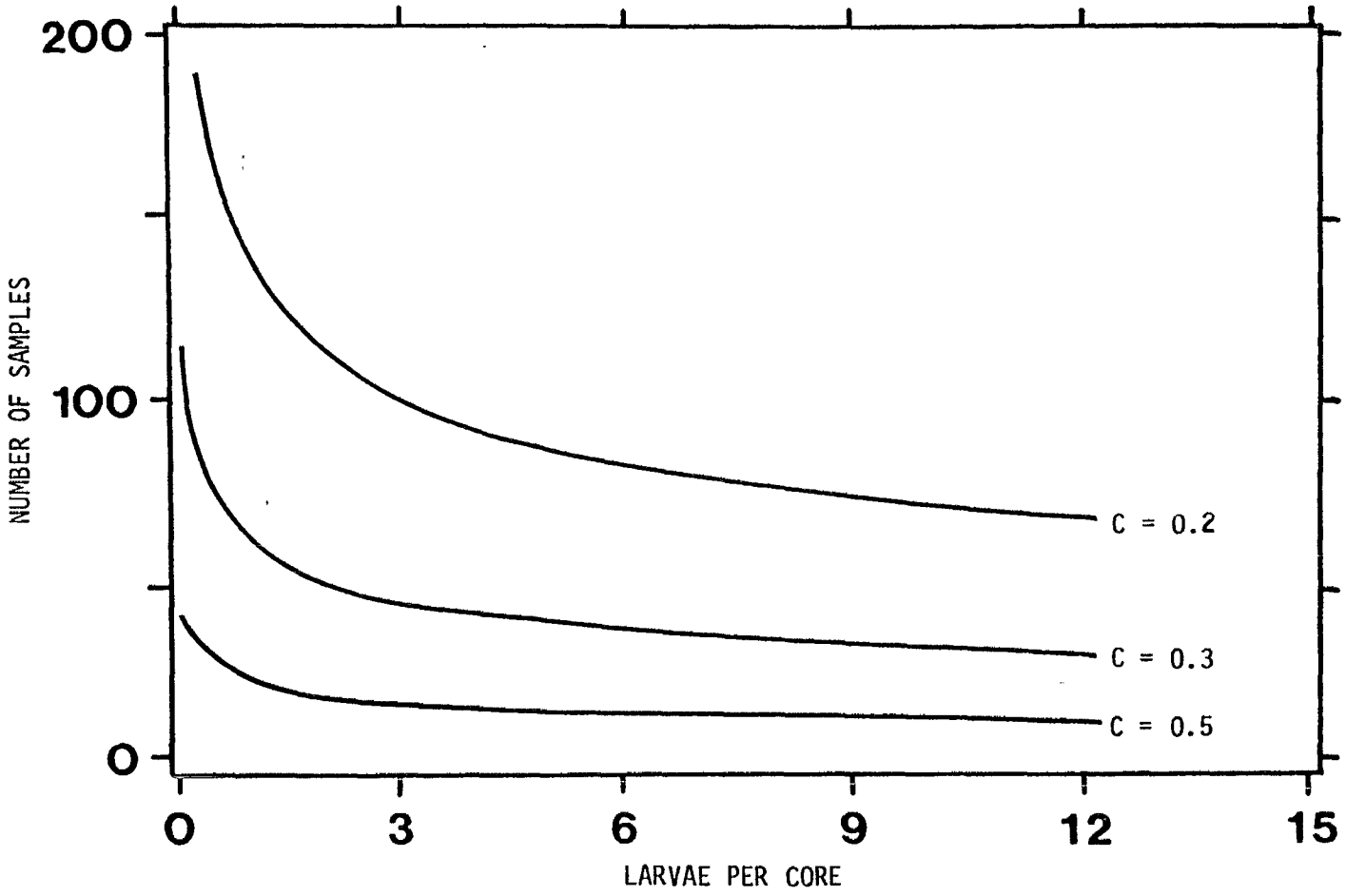

Figure 2. Optimum number of samples for sampling tobacco flea beetle larvae with varying levels of precision.

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Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

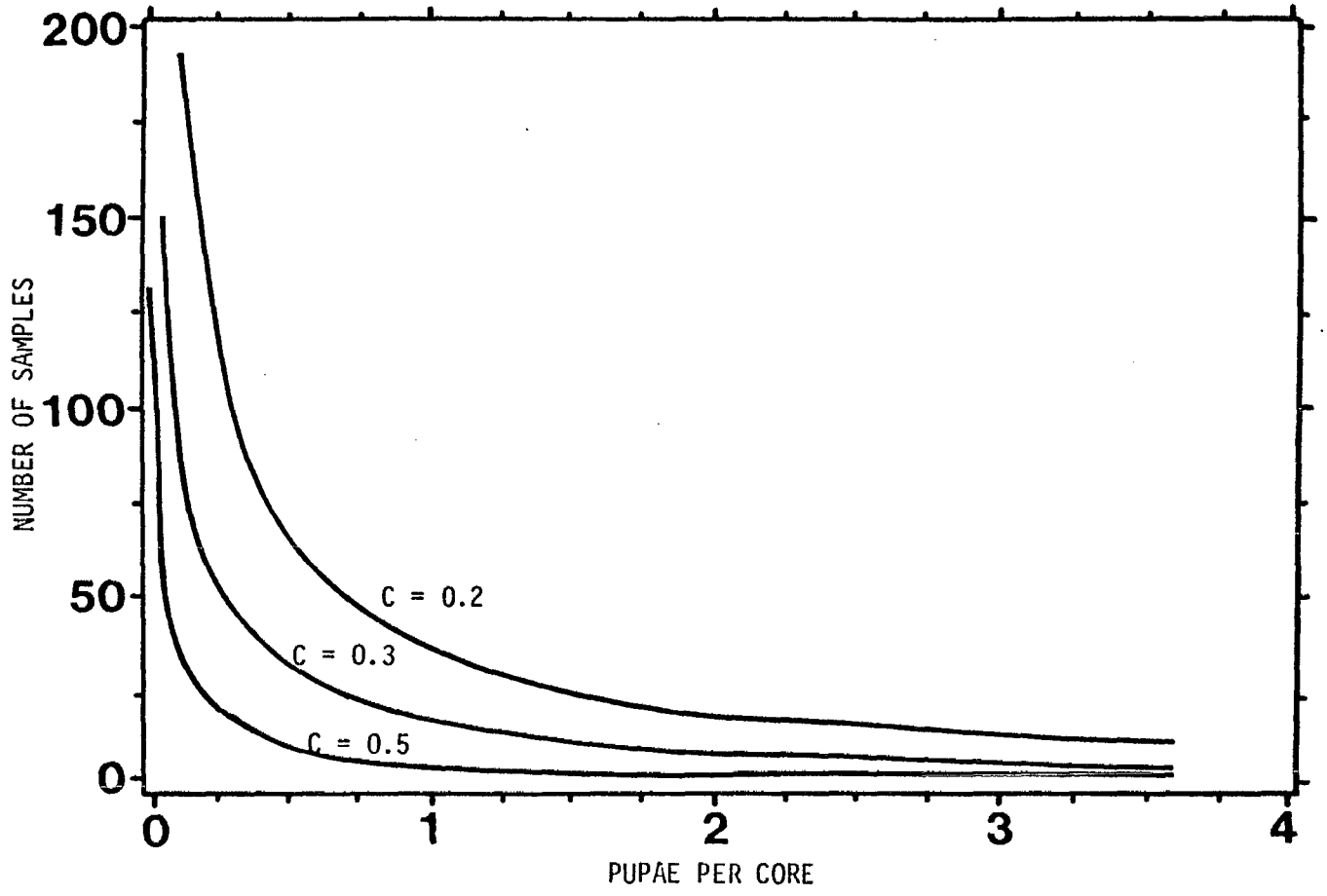

Figure 3. Optimum number of samples for sampling tobacco flea beetle pupae with varying levels of precision.

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Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

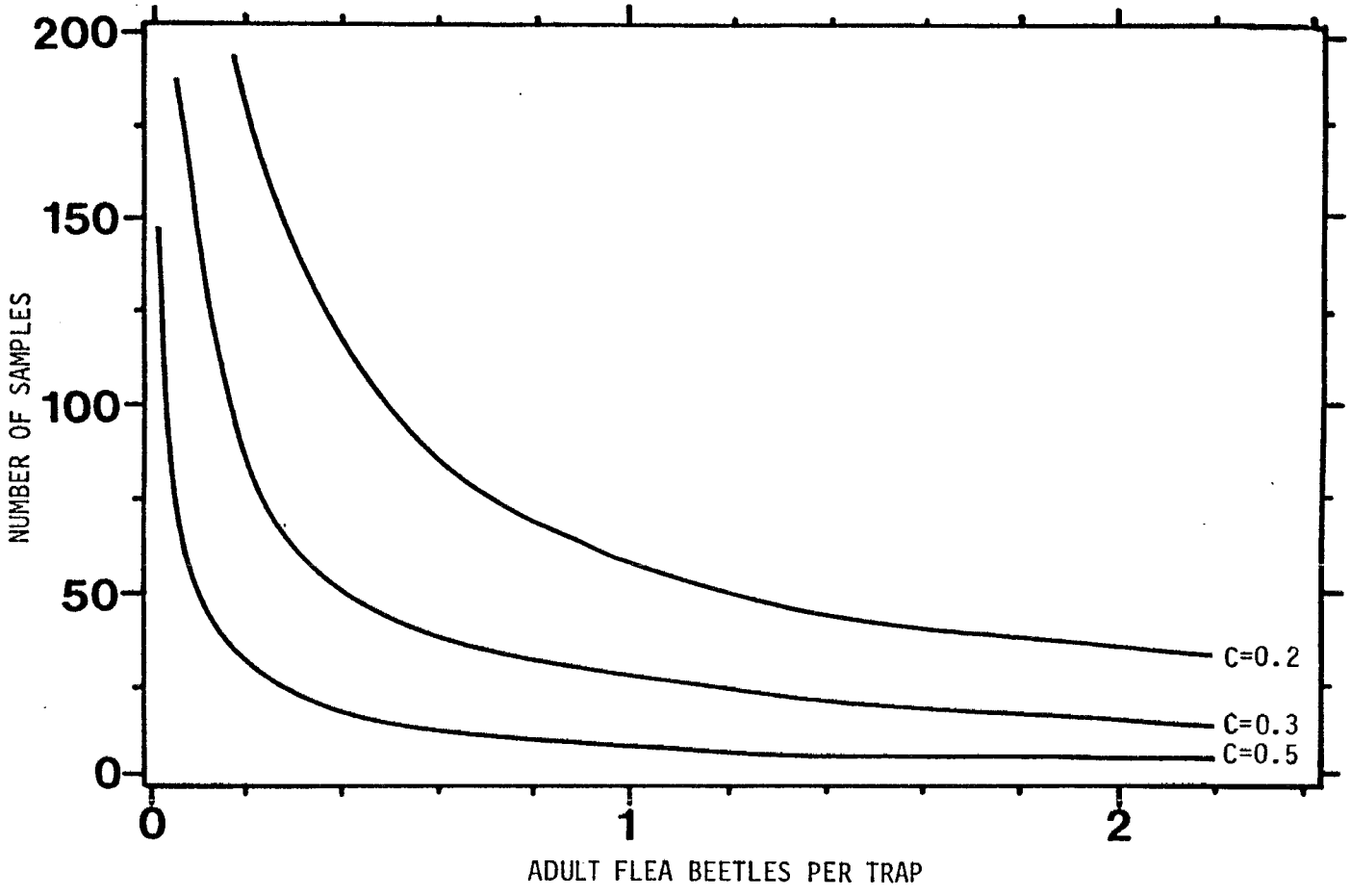

Figure 4. Optimum number of samples for sampling tobacco flea beetle adult emergence with varying levels of precision.

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Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

Figure 5. Progression of Primary and Secondary spread of TEV

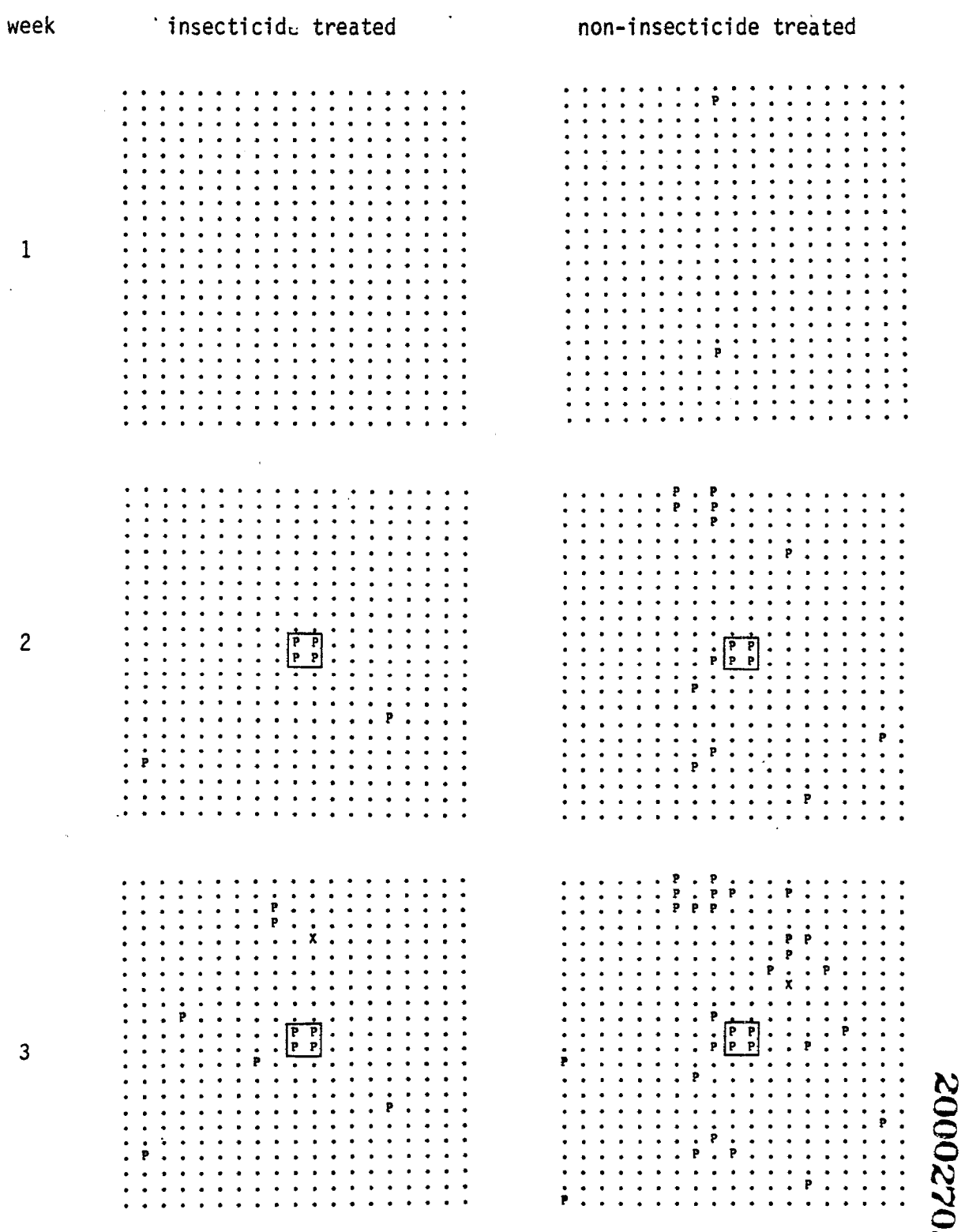

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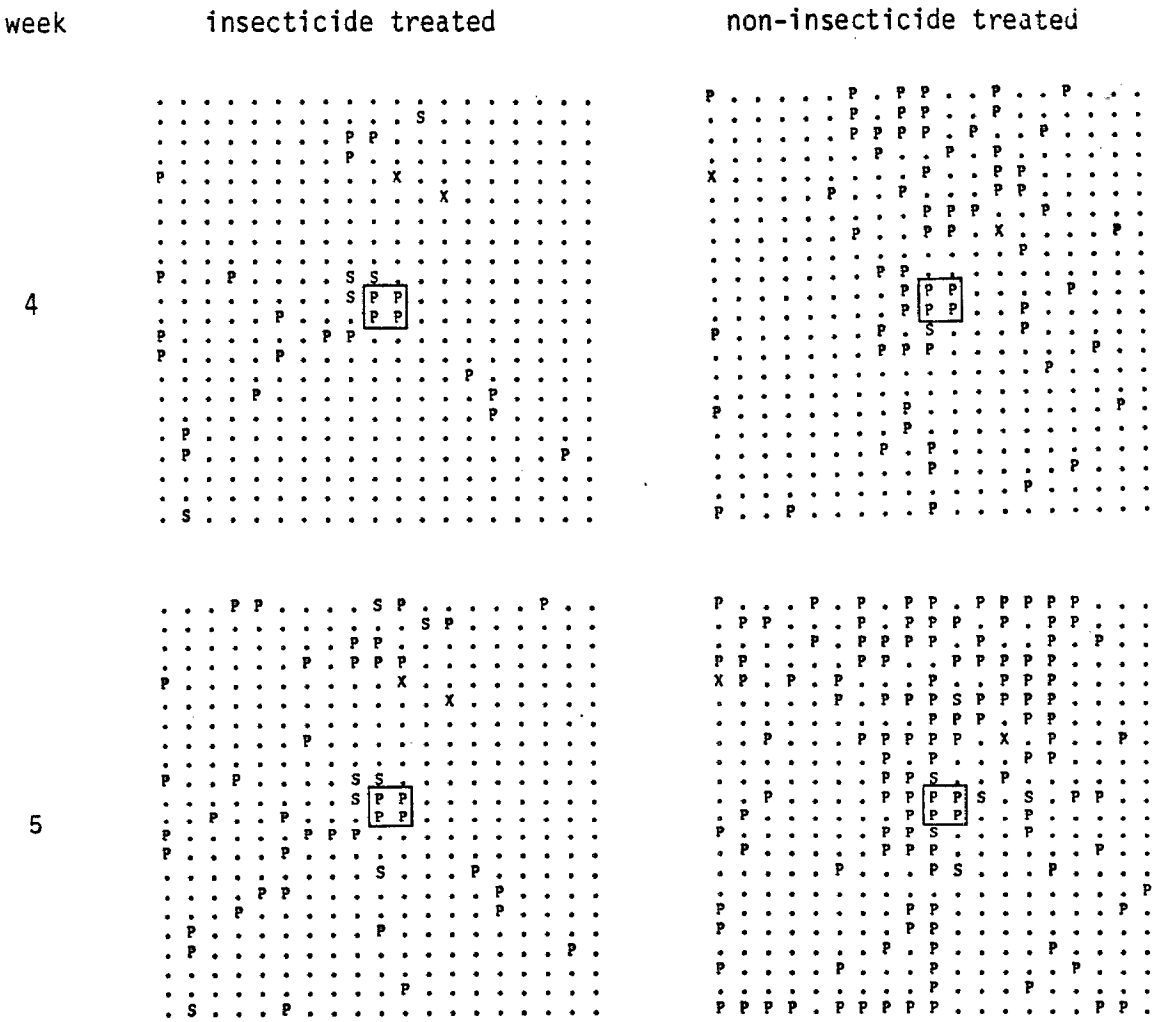
Figure 5. cont.



. = healthy plant
P = primary spread TEV
⊡ = inoculated plant (TEV)
S = secondary spread TEV
x = dead plant

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Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000

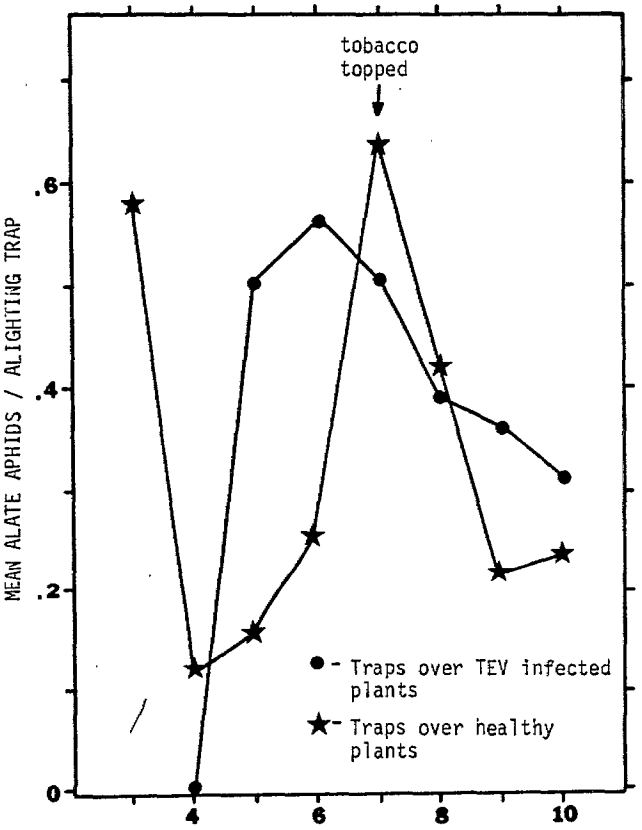

Figure 6. Mean aphids per alighting trap, Duplin County, NC 1985.

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Source: https://www.industrydocuments.ucsf.edu/docs/ftyk0000